The REFINER
AND NATURAL GASOLINE MANUFACTURER

Bubble Towers

[Construction Patented]

For improving existing distilling equipment or in combination with new distilling equipment

-- REFINERY DIVISION --

GRAVER Corporation

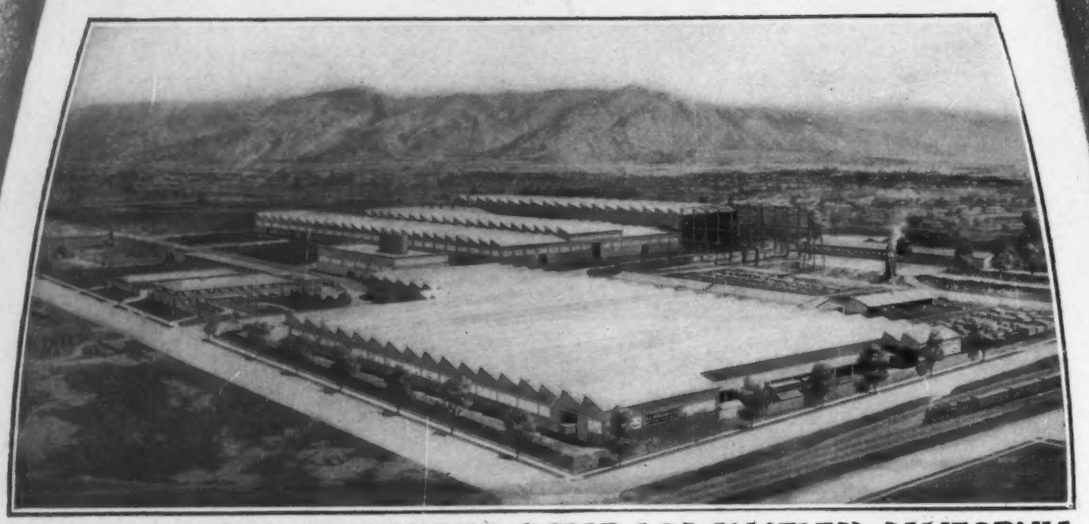
Founded 1857

844 Rush Street -- Chicago

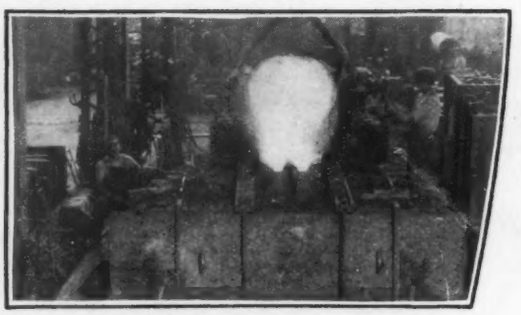
NEW YORK TULSA FORT WORTH LOS ANGELES

Plant --- East Chicago, Indiana

8 ACRES
OF FLOOR SPACE



30-ACRE WORKS • ALHAMBRA (NEAR LOS ANGELES) CALIFORNIA



EMPLOYED IN THE MANUFACTURE OF

BRAUN

HEAT TRANSFER APPARATUS

C. F. BRAUN & CO.

MANUFACTURING MECHANICAL ENGINEERS

ALHAMBRA - CALIFORNIA

TULSA DALLAS NEW YORK

BRAUN

Entered as second class matter June 16th, 1923, at the Postoffice at Houston, Texas, under the act of March 3, 1879

Vol. 7, No. 2

FEBRUARY, 1928

The REFINER

AND NATURAL GASOLINE MANUFACTURER

Edited Monthly at Tulsa, Oklahoma

GRADY TRIPLETT, *Editor* GEORGE REID, *Associate Editor*

TABLE OF CONTENTS

FINDING ITSELF 53
An Editorial by Grady Triplett

DEVONIAN PLANT DESIGNED TO HANDLE VARYING LOAD 55
By George Reid

MERCURY HEATED VACUUM STILLS YIELD SUPER LUBRICATING OILS 57
By C. M. Klemgard

FIRE MARSHALS ADOPT ACCIDENT PREVENTION AS PART OF ACTIVITY 59

THE BUDGET AND ITS PLACE IN REFINING OPERATION 60
By H. L. Kauffman

CONSTRUCTION DETAILS OF LUBRICATING OIL AGITATORS 65
By H. L. Kauffman

CHEMISTRY FOR THE TREATING PLANT OPERATOR 66
By L. J. Catlin

ONE FRACTIONATING COLUMN HANDLES VAPORS FROM SIX STILLS 69
By George Reid

A. I. M. E. REFINING SECTION PROGRAM ARRANGED 71

BURNING ACID SLUDGE AS REFINERY FUEL 73
By C. B. Faught and F. R. Staley

STEAM LEAKS AND HOW TO STOP THEM 75

VIEWS OF JOHNSON OIL REFINING PLANT, CLEVELAND, OKLAHOMA 76

FRACTIONATING EQUIPMENT INCREASES PLANT YIELD 77
By George Reid

BURNING OILS—THEIR CHARACTERISTICS AND MANUFACTURE 80

MODERN PRACTICE IN REFINING LUBRICANTS 90

LIFE OF MECHANICAL EQUIPMENT 92

ONLY REFINERY IN ARIZONA SUPPLIES LOCAL DEMAND 98

REFINERY AND GASOLINE PLANT ACTIVITIES 100

NEW EQUIPMENT, CATALOGS, BOOKS 106

ABSTRACTS OF TECHNICAL LITERATURE 116

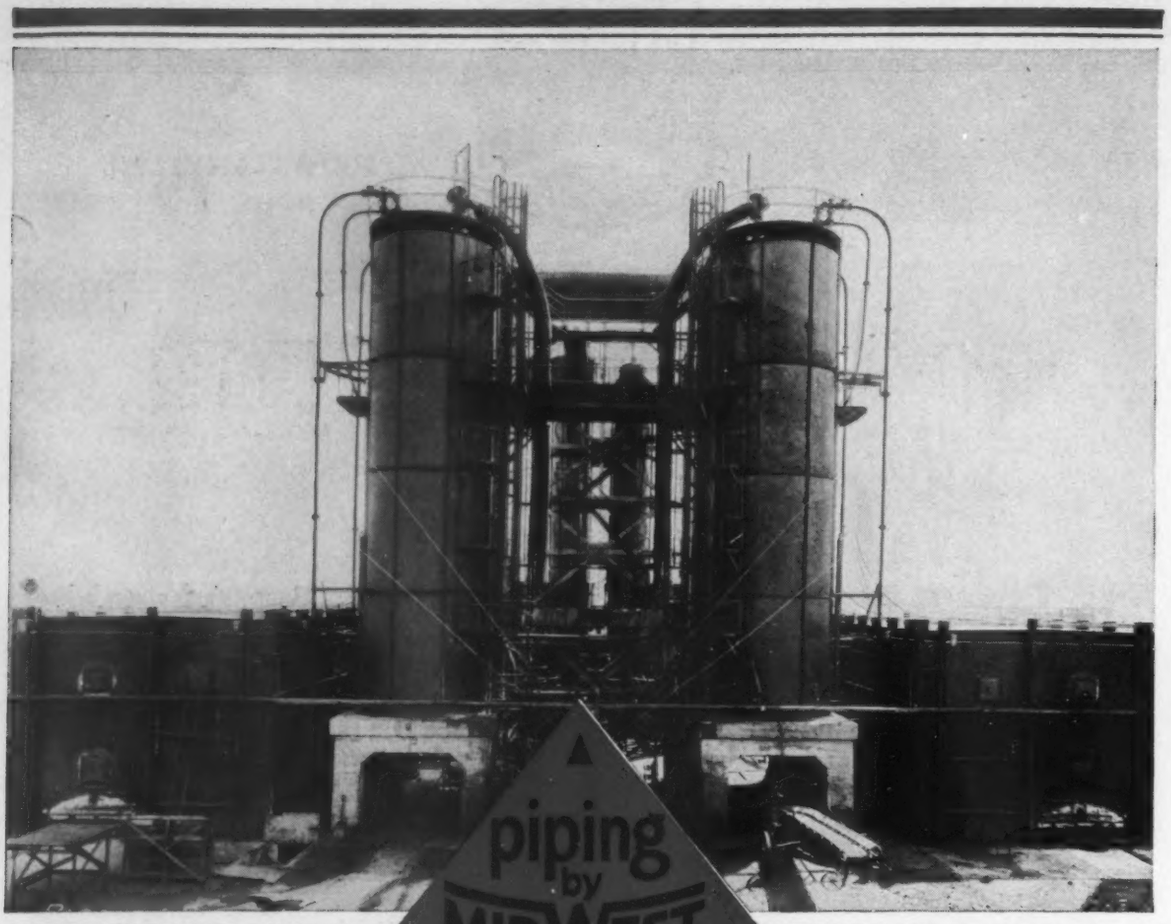
Published Monthly by GULF PUBLISHING COMPANY
Copyrighted, 1927

R. L. DUDLEY, *President* — A. L. BURNS, *General Manager* — SPENCER W. ROBINSON, *Editorial Director* — J. KENT RIDLEY, *Managing Editor*

Editorial Office: 214-218 Atco Building, Tulsa, Oklahoma

Office of Publication: 3301 Buffalo Drive, Houston, Texas

NEW YORK: Room 832, 250 Park Avenue, R. P. Swinsky, Manager. *PITTSBURGH*: 510 Park Bldg., W. W. Pigue, Manager. *CHICAGO*: 476 First National Bank Bldg., O. R. Waller, Manager. *LOS ANGELES*: 1201 Haas Bldg., Wm. V. Gross, Manager. *TULSA*: 214-218 Atco Bldg., J. F. Carter, Jr., Manager. *FORT WORTH*: 203 W. T. Waggoner Bldg., H. H. King, Manager. Single copies 20 cents. Domestic Subscription price, $1.00 a year. Foreign Subscription price $1.50 a year. Advertising rates upon application.



Dubbs Stills *at* Paragon Refining Co.

At the Paragon Refining Co., Toledo, Ohio, is another of the many installations of Dubbs Stills in this country and abroad that are equipped with Midwest Piping and Midwest Joints.

At both the St. Louis and Los Angeles plants, Midwest has the facilities and organization to quickly and efficiently fabricate any piping you may require. You are assured prompt attention, intelligent interpretation of drawings and specifications and fabrication in accordance with the most modern practice. Midwest is not hampered by the traditions of piping design and fabrication—the policy is to improve and simplify wherever possible. Competent engineering service is available when desired to solve any piping problem.

You also will find it advantageous to specify piping by Midwest whenever you require fabricated piping. Get in touch with the office nearest you.

MIDWEST PIPING & SUPPLY COMPANY

Plants at Los Angeles and St. Louis

Offices: Los Angeles, 520 Anderson Street. Tulsa, 805 Mayo Bldg. St. Louis, 1450 S. Second Street. Chicago, 208 S. LaSalle Street

MIDWEST Piping Service

Mention Where You Saw the Advertisement

Finding Itself

NATURAL gasoline as a motor fuel is now a fact. It has superior qualities for both the airplane and the automobile motor.

Plans now being perfected shortly will be put in force to sell these products on a broad scale. Some of these plans involve sales direct to consumers. Others will put natural gasoline in the hands of jobbers for distribution to customers.

From these efforts the natural gasoline should establish itself as an entity. Instead of being buffeted by the whims of economics conditions and powerless to fight for any standing, natural gasoline will have the facilities for determining its own status.

It has not been many years back that natural gasoline found its way to market by being mixed with kerosene. In times of stress it was not welcome, even in kerosene. Frequently owners of plants sougth the privilege of pumping natural gasoline into crude oil.

Natural gasoline seemed in those days to be the "bad boy" of the petroleum family. It was welcome when conditions were favorable. When economic conditions were blowing a storm none wanted the care of an unruly youngster.

Science must be given credit for changing this "bad boy" into a useful individual. As a finished motor fuel in the visible bowl of a service station pump, natural gasoline is far from the product it was when it could be mixed with kerosene. In a pump bowl it is a product different from what it was just a few months back, when it found its only outlet as a blend for straight run or cracked gasoline at refining plants.

As natural gasoline changes into a motor fuel, those charged with the duty of selling it should be armed for a mettle testing effort. Excellent motor fuels are numerous. To sell natural gasoline from pumps will require effort and ingenuity.

The condition presents one advantage. Many of the concerns contemplating the sale of natural gasoline as a motor fuel are new in the field of retail selling. While these executives have much to learn, they are likewise fortunate in having nothing to unlearn. The selling of gasoline has fallen into ruts.

Those who sell natural gasoline should avoid those ruts. Perfecting an excellent product and putting it in available pumps, providing billboard publicity and signing contracts for newspaper space does not constitute merchandising.

There are numerous excellent gasolines. Sufficient service stations are convenient. As for billboards and newspaper space, they are so prevalent, they are common.

All these efforts the sellers of natural gasoline may provide. But if nothing more is done, natural gasoline will be in the merchandising rut of other gasolines. It is time for someone to put some new notes into the selling of petroleum products. Why not natural gasoline.

Recently pages of this publication have presented methods by which contact has been maintained with customers through letters. Another merchandising effort recalled involved selling lubrication by yearly contracts. These were examples of individual selling.

There must be scores of others. Natural gasoline deserves them.

Grady Gilbert

Now There are Four More

The last time this installation was used in a Cooper advertisement there were 32 Cooper four-cycle 170 H. P. twin engines in the row. Since then four more have been added, making thirty-six, or a total of 6,120 H. P. It is Sinclair Oil & Gas Company's plant No. 13 in the Seminole Oil Field and is generally conceded to be the largest gasoline plant in the world.

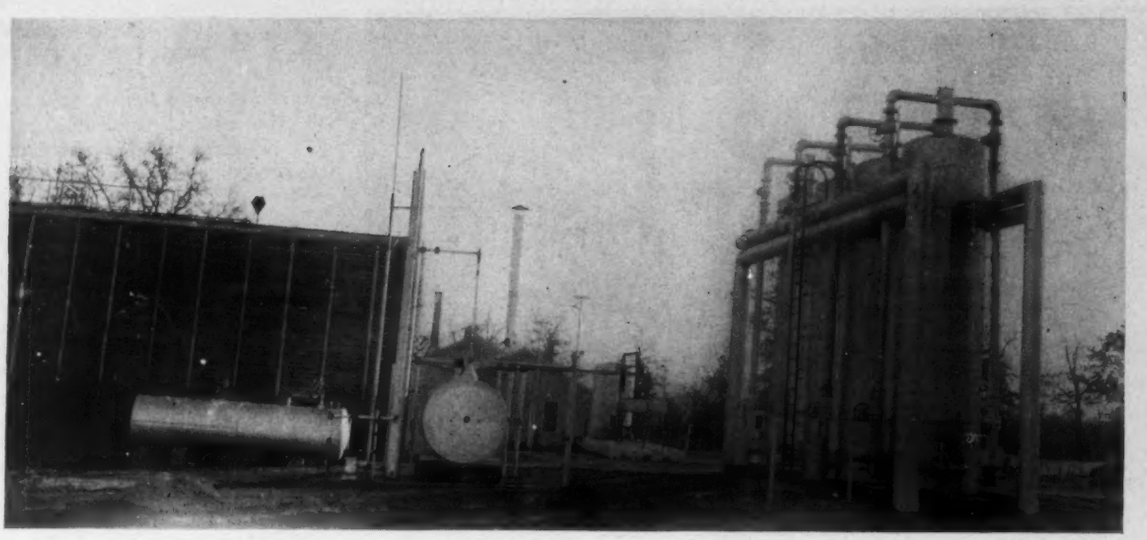
It is to be expected that for installations requiring such investments, Cooper equipment would be chosen. First, because it has proved so thoroughly dependable and, second, because of the policy of fairness and friendly service back of it.

Cooper gas engines are built in standard sizes from 50 to 1500 B.H.P. for every power purpose.

The C. & G. COOPER COMPANY
MT. VERNON, OHIO

1111 Magnolia Bldg., Dallas
604 Kennedy Bldg., Tulsa
649 S. Olive St., Los Angeles

COOPER



GENERAL VIEW OF DEVONIAN OIL COMPANY'S OSAGE GASOLINE PLANT NO. 3

Devonian Plant Designed to Handle Varying Load

By GEORGE REID
Associate Editor

WITH the volume of natural gas varying from about two and one-half million cubic feet to a peak load of approximately seven and one-half million feet, and this variation occurring sometimes daily, the Devonian Oil Company operating its Osage Gasoline Plant No. 3 on the northern outskirts of Tulsa, is extracting gasoline from the gas to the extent that the residue often shows a content of only 25 gallons per million feet. By charcoal test the gasoline content of the residue varies between .025 gallons per thousand to the maximum of .045 gallons per thousand.

The varying load condition is explained by the fact that the volume of natural gas treated at this plant is governed by the consumption of gas for domestic and industrial purposes in Tulsa. The plant serves as a conditioning installation for a portion of the gas consumed by the city. The greater variation of gas volume treated naturally occurs during winter, when large volumes of gas are consumed during the morning hours. The same variable condition, however, exists throughout the year, with the peak load falling in the morning. At one time during winter months in this territory the plant handled a load varying from one-half million cubic feet as "low" to a "high" of 17,000,000 cubic feet. In short, it appears that the volume of gas to be treated each day is dependent solely upon weather conditions.

Under such conditions the plant operates smoothly and efficiently, which indicates that the equipment from pumps, temperature controllers and water traps, to absorbers, still, and cooling coils must have a high degree of flexibility, and that plant operators must be "on their toes." Because of the method of operation and the inconstancy of through-put, it is interesting to note the smoothness and efficiency with which the installation does its work.

When changes in volume of gas occur, it is sometimes necessary to increase the rate of oil circulation and to put additional absorbers in service.

The plant, however, has wide limits of flexibility and it is only necessary to increase oil circulation, etc., when very abrupt changes in volume over a wide range occur. Experience during the past four years with the plant, changing weather conditions, which can be unusually abrupt in this area, is of much importance, for the operators can anticipate the demands to be made upon the equipment, and prepare for larger peak loads.

Absorber Operation

The installation of absorbers is of particular interest, since this equipment was designed for operation under changing volumes. There are four absorbers of Newton type. The entire plant, in fact, is Newton process. The absorbers are manifolded in such a manner that as many of them, or as few, as is necessary to handle the prevailing load may be placed in service.

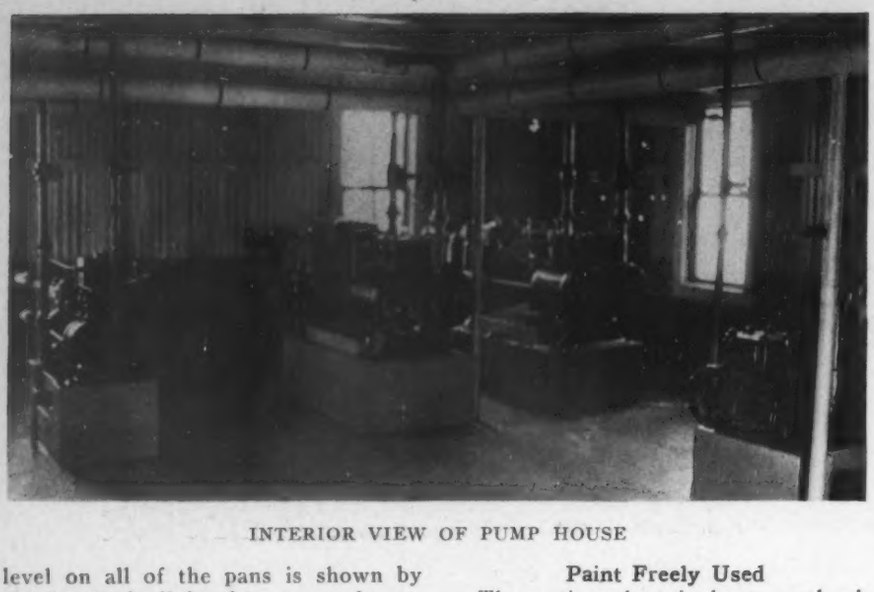
Natural gas enters the plant under pressure of around 35 pounds. After scrubbing, it is conducted to the absorbers and the stream split into two headers. The headers are made of 6⅝-inch pipe throughout. Gas entering the headers is distributed to the absorbers through smaller lines conducting it to the bottom of the absorber towers. Through this practice the gas to be treated is conducted into the absorber from both sides. At the time of the writer's visit, two absorbers were in service, which caused the gas stream to be split five times as it passes into the two headers, then into the four lines leading to the towers. Instead of passing the gas into the towers through a single line, and by sending it into the bottom of the tower in equal volumes from both sides of the tower, better distribution is secured and less channeling inside of the tower occurs. Many tests have been made at the plant which tend to show that the header system and dual entry of the towers secures very even distribution.

Gas is also removed from the top of the towers from each side. Lines conduct the gas from both sides of the tower to a second header. Through this header line it is conducted away from the plant and piped into the city for fuel.

Absorption oil is also taken into the absorbers through a header arrangement, with small lines branching off of the header lines and leading into the individual tower. Oil is conducted to the top of the absorbers and passes downward over the plates. Each oil line to towers is equipped with a strainer or trap in which any foreign matter not previously strained out is caught, and in which any water present drops out. The traps are equipped with detachable heads and blow-off valves. Due to the simplicity of the header type manifolds, it is a simple matter to cut in another absorber when needed or to take one out of service when it is not required.

Gauges Lighted

Gauge glasses are provided at each pan in all of the absorbers. The liquid



INTERIOR VIEW OF PUMP HOUSE

level on all of the pans is shown by the level of oil in the gauge glasses. It is possible for the operator to make a hasty inspection of the condition of all of the pans in the working absorbers from a reasonable distance from the equipment. If any particular tray becomes ineffective, carries over, is plugged, etc., its condition is quickly discovered by the operator, and steps taken to correct it. For visibility of the indicating gauge glasses at night, a light has been placed above each tier of them at each absorber. This feature of inspection is of much importance, especially where a plant operates under such variable load conditions as does this one.

Fat, or enriched oil, leaving the absorbers through a second header arrangement is conducted to a nearby vent or fat oil tank, where the gases in solution are released and conducted to the boilers for fuel. Fat oil then goes to the exchanger, preheaters and still in the usual manner. Live steam is used in both still and preheater. Temperature of the dephlegmator is controlled by a Foxboro automatic temperature controller, and the end point of the product is governed by this temperature control.

The operators specialize on a premium grade of gasoline. The product has the approximate specifications of 68/70 gravity, 330 end point, 95 per cent recovery and 6 to 8 pound vapor tension. The peculiar characteristics of the gas treated make possible the manufacture of this type of stable gasoline.

Since rust, scale and similar foreign matter flake off of cooling coils, due to their expansion and contraction, the absorption oil which is passed through these coils is put through Fisher strainers as it leaves the coils. Twice daily these strainers are cleaned. While one strainer is being cleaned, the oil flow is by-passed through one coil only. Then the second strainer head is taken off, the bucket removed and cleaned. The frequent cleaning of the strainers, which requires but a few minutes, insures that scale particles, sand and other foreign matter will not get into the pumps to ruin liners, valves, etc.

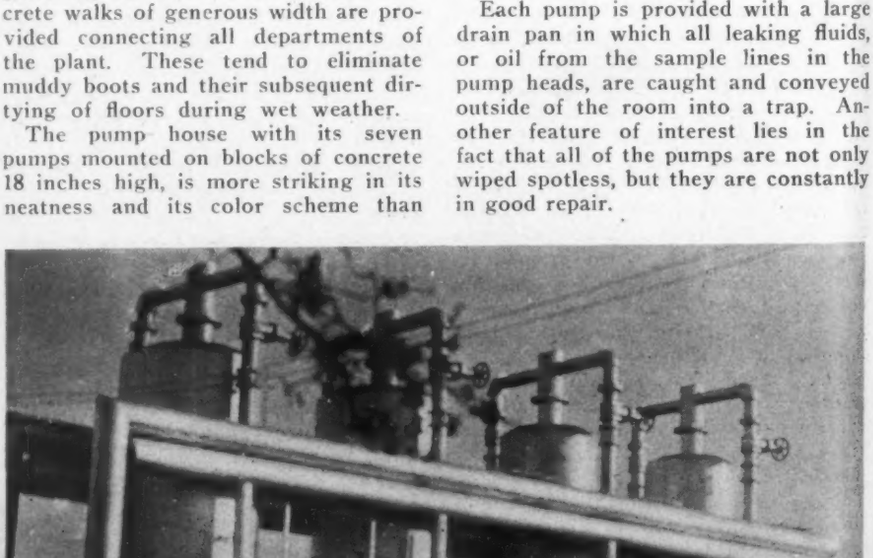
Paint Freely Used

The entire plant is kept spotlessly clean. On all of the outside equipment, aluminum paint is applied and renewed when necessary, keeping the plant sparkling. Where aluminum paint is not applicable, black paint is used, with occasional trimming of red applied on valve wheels and small connections. Office building, power house and pump house are all metal construction with preservative coatings of paint applied both inside and out. Concrete walks of generous width are provided connecting all departments of the plant. These tend to eliminate muddy boots and their subsequent dirtying of floors during wet weather.

The pump house with its seven pumps mounted on blocks of concrete 18 inches high, is more striking in its neatness and its color scheme than most. All of the top of the pump house is painted white, sills, rafters and inside of roof, with white insulation materials neatly trimmed in red at the encircling metal bands. The pump house floor is painted gray and washed clean with hose and water each morning. The walls to a height of about three feet are covered with dark green paint—above this level they are white. The dark green at the bottom is more easily cleaned.

All of the concrete bases supporting pumps are covered with tan paint, and the pumps themselves are covered with black paint on the steam end, offset by a coat of green paint on the liquid side. Liquid lines inside of the building have the usual aluminum covering. Electric wiring for lights is all in the usual black conduit, with black wire protectors over all of the globes. It seems that the operators on duty, after employing an ingenious color scheme of black, green, tan, white, gray and aluminum, discovered that something was lacking and the pump house colorings were perhaps a little flat—for they followed behind the larger brushes and applied coatings of green paint on all of the small fittings and connections, and then added a really decorative effect by trimming all of the valve wheels, and all of the nuts and bolts with a "live" red paint.

Each pump is provided with a large drain pan in which all leaking fluids, or oil from the sample lines in the pump heads, are caught and conveyed outside of the room into a trap. Another feature of interest lies in the fact that all of the pumps are not only wiped spotless, but they are constantly in good repair.



DETAIL VIEW OF ABSORBERS SHOWING GAS HEADERS DISTRIBUTING GAS TO THE TOWERS

Mercury Heated Vacuum Stills Yield Superior Lubricating Oils

By E. N. KLEMGARD

THE over-production of crude oil has made it necessary for refiners to instigate researches in all phases of their particular fields with a view to reducing costs. One such investigation, having as its object the production of lubricating oils at a reduced cost, has resulted in the development of a process in which acid treatment and clay filtration are eliminated. In brief, it may be stated that this process is a novel combination of high vacuum distillation of topped crude treated with a small portion of sodium hydroxide, in a series of stills which are heated with mercury vapor.

The use of high vacuum stills, while not general, is rapidly increasing. Unsettled patent litigation is one of the factors retarding rapid development in this direction. By high vacuum an absolute pressure of less than 10 mm. of mercury (0.3937 inches) is referred to.

There are several vacuum stills operating successfully on both the Pacific and Atlantic coasts but it appears doubtful that these offer any great advantage over the up-to-date pipe still, with its consequent elimination of rerunning and high fuel economy.

In general, vacuum distillation is more applicable to naphthenic or asphaltic base crudes than to paraffin base oil. The distillation of the relatively low boiling naphthenes at moderately high vacuums followed by acid treatment or clay treatment or a combination of these has been practiced by some refiners for several years. One of the advantages of this type of refining is that the lubricating distillate is of lighter color and consequently requires less acid treatment. An added advantage is the increased yield of lubricating distillate which is due in part to decreased decomposition of the hydrocarbons at the lower distilling temperatures. Vacuum distillation also is responsible for considerable savings in fuel over atmospheric stills.

Rapid Development Possible

The future rapid development of high vacuum distillation is quite probable and one of the large refiners on the Atlantic Coast is producing lubricating oils of high quality by high vacuum-distillation in mercury heated stills. For some time this concern has been handling 2200 barrels of topped crude each day but has recently constructed a new plant having a capacity of 8000 barrels per day. The successful operation of the new plant and the ease with which the new and improved lubricating oils may be marketed are apparent indications that the growth of this process will be watched with great interest.

The inherent difficulties existing in the usual process of distilling lubricating oil at atmospheric pressure may be pointed out as high temperatures of distillation, local heating of still bottoms and refluxing. The introduction of steam during the distillation in shell stills does not overcome all of these difficulties, although an improvement in the quality of the overhead stocks is usually noted. Due to the fact that very few of such plants are properly equipped to accurately measure the steam going to the stills and fractions, the amount employed is left to the stillman's preference and in many cases considerable steam is wasted and fuel efficiency decreased.

The mechanical condition of the shell still is often an important factor bearing on the extent of cracking produced in the oil being distilled. This inherent tendency of shell stills to crack the oil during distillation must be prevented, and this at times calls for the introduction of large volumes of steam. It is also important that the quantity of steam be sufficient to agitate the oil and thus assist in the prevention of excessive "shell cracking." In spite of the use of steam to reduce vapor pressure and thus bring about distillation at slightly reduced temperatures and also to reduce cracking by mechanical agitation of the oil, it is found to be general practice to complete the manufacture of the lubricating oil by decolorizing it by one of several processes in order to meet the market demand for lubricants of light color.

In one system of refining oil to produce satisfactory color, finely divided clay is intimately mixed with the hot oil, the mixture cooled, and sometimes blended with light oil and then passed through filter presses for the removal of the clay. This process is termed contact filtration. The procedure of filtering the oil through a column of clay is also widely used and is known as percolation.

Acid Processes

The use of strong sulfuric acid and in some cases liquid sulfur-dioxide by the Edleaneau process, are also in general use. In some cases the acid treated oil is further refined by clay percolation. One of the leading refiners of lubricating oil on the Pacific Coast is now using the Edleaneau process on a considerable part of its products. It is estimated by Dr. T. G. Delbridge of the Atlantic Refining Company (REFINER AND NATURAL GASOLINE MANUFACTURER, September, 1927) that the general cost of processing is distributed about as follows:

Fuel, Stills, etc.	40
Process Labor	20
Maintenance	15
Chemicals, Clay	15
Sundry expense	10
	100%

By the process of producing lubricating oils by high vacuum distillation in mercury vapor heated stills, no chemicals (except a small amount of caustic soda) acid, or clay are employed. Hence this item of expense is not incurred. While the process labor which amounts to 20 per cent of the total processing cost may be greatly reduced, this savings is not realized due to an added cost for maintaining the high vacuum. A conservative estimate places the reduction in processing cost as 25 per cent.

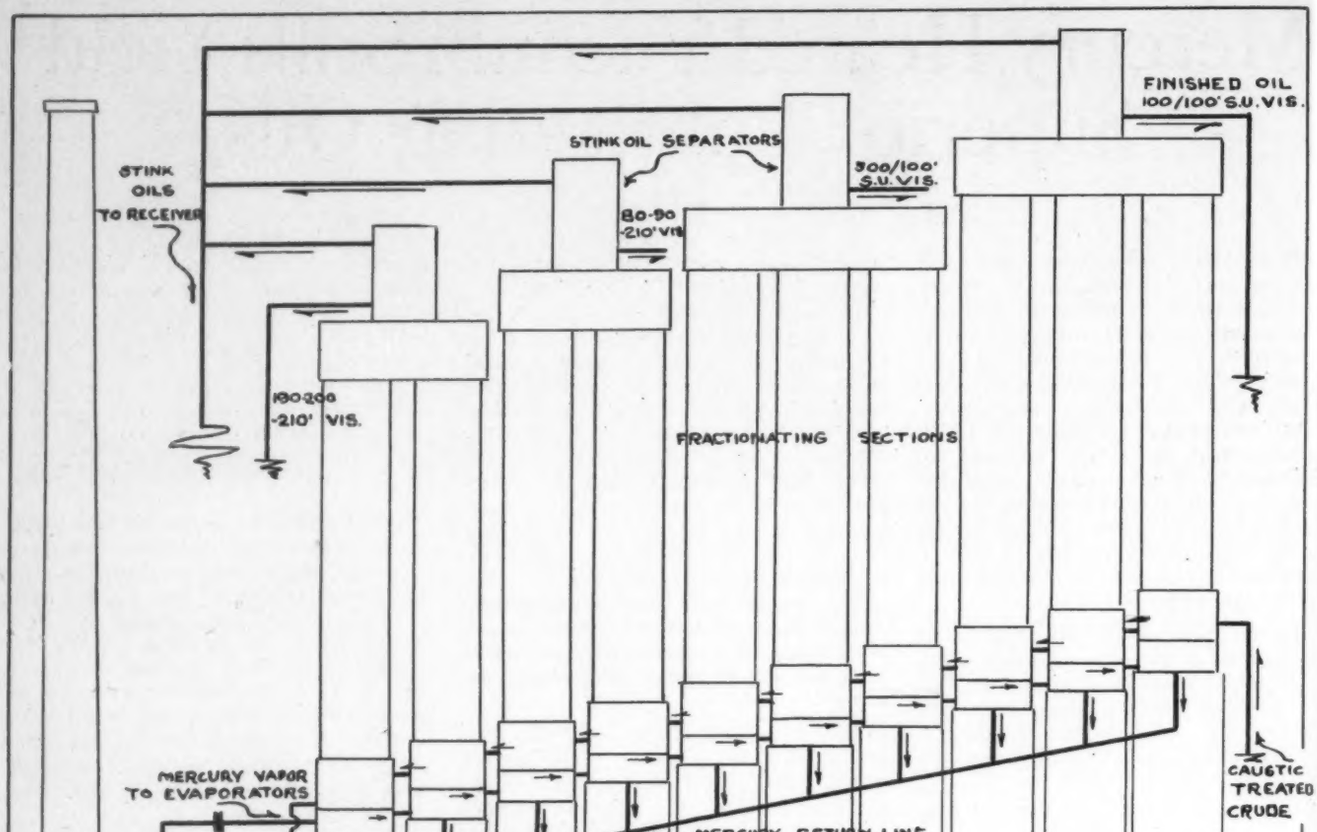
The use of vaporized mercury for heating reaction mixtures is not new in the practice of chemical engineering but its adaptation to the heating of vacuum stills used in fractionating petroleum has only recently become of commercial value. One of the properties of mercury that makes it of particular value in this new use is its boiling point, which at normal atmospheric pressure is 675 degrees F (357.25 degrees C.).

The liquid mercury used in this new method of refining is vaporized in a special boiler. This boiler is so designed that most of the vaporization takes place in vertical steel tubes closed at the bottom and open at the top. The heating tubes are about 4 inches in diameter and are of extra heavy construction. The liquid mercury enters the top end of the tubes and drops to the bottom, which is exposed to the flames of the furnace. When the mercury has attained a temperature of 680 to 700 degrees F. (depending on the pressure of the system) it is vaporized and passes out of the tops of the heating tubes to a vapor chamber which composes the upper part of the mercury boiler.

Mercury Under Pressure

The entire mercury vapor system is maintained under a pressure of 8 to 10 pounds per square inch above normal atmospheric pressure, thus the temperature of the vapor may reach the range of 680 to 700 degrees F. while the normal boiling temperature of the mercury is only 675 degrees F.

From the mercury boiler the vapor passes to a series of ten reboilers where the oil is heated to its boiling point. The



mercury vapors pass in counter-flow relationship (through the series of reboilers) to the oil being fractionated. Thus the vapors from the mercury boiler first enter the reboiler or evaporator in which the heaviest oil is being fractionated. As the mercury gives up its heat to the oil a portion of it is condensed and drops to the bottom of the mercury chamber of the avaporator, where it enters a pipe line and flows by gravity back to the mercury boiler. Here the mercury is vaporized again and recycled to the evaporators.

The mercury vapor which is not condensed in the evaporator passes up to the next evaporator, and so a portion of the mercury vapor from the mercury boiler passes through the series of 10 evaporators in the last of which hot, caustic pretreated, topped crude is being pumped. During its passage through the 10 evaporators practically all of the mercury vapor is condensed and drops down into the mercury return line and flows to the mercury boiler for re-evaporation. The 10 oil evaporators are set at a proper incline to the horizontal to allow sufficient drift so the condensed mercury readily flows by gravity to the boiler.

Charging Method

Topped Smackover crude, which may be satisfactorily refined by this process, is heated with from 1 to 2 per cent of a solution containing 50 per cent of caustic soda (NaOH) in a shell still. This crude before being treated with the caustic has an organic acidity which is equivalent to 0.8 mg. of caustic potash (KOH) per gram of oil. It is believed that the crude contains about one half of one per cent of naphthenic acids. These acids have the general chemical formula of C_nH_{2n}—$2O_2$ and members of the series having boiling points of 380 degrees F. to 650 degrees F. and from 15 to 30 carbon atoms no doubt exist in the topped crude. After leaving the treating still the topped crude is heated from 350 to 450 degrees F. in heat exchangers and refluxers before entering the first evaporator. One of the reactions taking place between the caustic soda and the oils is known to be the neutralization of the naphthenic acids, however considerably more caustic soda than is required for the neutralization of these acids is employed, and during the heating and boiling of the oil reacts with some of the hydrocarbons.

That this is the case is indicated during the evaporation of the treated oil when a considerable proportion of relatively unsaturated, low-boiling oils is produced which has a very foul odor and is termed by the stillmen "stink-oils." The sodium compounds of these unidentified hydrocarbons are apparently decomposed during the distillation process and in some cases a deposit of caustic soda and sodium is left in the evaporators and still. In one instance sufficient sodium was formed to react with water to form hydrogen, when the still was being cleaned. This hydrogen when ignited, will explode.

The oil after being vaporized by the mercury in the evaporator sections passes upward into fractionating columns, one fractionating section being provided for each evaporator. In some cases two or more of the fractionating sections are joined at their upper ends by horizontal sections which may carry refluxers. Projecting upwards from the horizontal sections are additional fractionating units which may be termed, "stink-oil" separators. From the top of each "stink-oil" separator (there are usually four such separators in the ten unit arrangement are pipe lines through which the "stink-oil" vapors pass to heat exchangers and condensers.

Oil Under Vacuum

The entire fractionating system is maintained under highly reduced pressure. A vacuum ranging from six to seven mm. of mercury, on the fractionating section, gives satisfactory results.

From near the bottom of the "stink-oil" separators the finished oil lines run to receivers. After being condensed and cooled these oils do not require further treatment but are ready for packaging or blending. Reference to the following table of the physical and chemical properties of the four streams of finished oil leading from the fractionating sections will indicate conclusively the tremendous advantages of this unusual process as compared with the

refining by ordinary distillation followed by either acid or clay treatment.

Tests on Oils Produced by High Vacuum Distillation in Mercury Heated Stills
(Commercial Scale)

Oil No.	Grav. °Be.	Flash °F.	Fire °F.	S. U. Vis. 100°F.	S. U. Vis. 210°F.	Cold Test °F.	N. P.A. Color
1	20.2	325	375	100		0	2¼
4	17.6	385	445	500		0	2½
6	14.7	430	495		80-90	04	3
8	13.3	470	560		190-200	37	4
By making suitable changes in the method of operation the following oils may also be produced.							
2	18.9	360	410	200		0	2¼
3	18.1	370	430	300		0	2¼
5	17.2	390	455	750		0	2½
7	13.6	455	530		150-160	34	3½

The "stink-oils" as has already been mentioned, are produced during the distillation and are probably decomposition products of the sodium compounds of certain hydrocarbons existing in the crude. They have a very foul odor and are relatively light bodied and highly unsaturated. The quantity of these oils produced during the process represents about 9 per cent of the topped crude charged to the stills.

Uniform Heat Distillation

Features of this process which may be responsible for the production of such highly viscous oils having at the same time a very pale color, are that the use of mercury vapor for bringing about the evaporation of the oil gives an even distribution of the heat throughout the evaporator with no local overheating and also that the degree of heat may be very closely regulated.

The Number 7 oil may be used with exceptionally good results as a Bright Stock, having characteristics which are not found in Bright Stocks produced by the usual refining processes. It has a very light color combined with a Saybolt Viscosity of 160 at 210 degrees F., a Cold Test of 34 degrees F. or less, Conradson Carbon of less than 1 per cent and a good Demulsibility. These characteristics which are found in the Number 7 oil make it particularly adaptable for blending in the production of automobile motor oils. The Conradson Carbon value of this lubricant will range from 10 to 25 per cent of that given by the usual Bright Stock found on the market. Due to the facts that the Number 7 oil is a wholly distilled product, from an intermediate base crude, and also on account of not being treated with sulfuric acid which may produce sulfo-compounds and polymerized, high-boiling hydrocarbons, it is claimed that this oil when used in internal combustion engines gives a very fluffy carbon, most of which is readily blown out of the combustion chamber by the exhaust gases.

Another feature of the Number 7 oil, which is also shared by the other members of the series, is its low volatility. Accurate control, carefully designed fractionating equipment operating under high vacuum with practically no shell cracking are the most important factors which make is possible to produce a Bright Stock having a distillation range of practically 50 degrees F. Bright Stocks produced by the usual methods of refining, will in general have a distillation range of 300 degrees F. This is a very important characteristic when considering lubricants for internal combustion engines, as for two oils having practically the same average boiling point and viscosity, but differing in their distillation range, it will be found that the one which has the smallest range (sharpest cut from crude) will give a minimum of consumption in an engine.

Number 2 oil and the Number 7 Bright Stock may be blended to produce any required viscosity, as follows:

S. U. Viscosity of Blend 100°F.	300	500	750	1000
No. 7 Bright Stock 150 at 210°F.	15%	31%	42½%	52½%
Number 2 Oil 200 at 100°F.	85%	69%	57½%	47½%

In order to show the appreciable saving made by using the two oils produced by this process, blends of the Number 7 with a regular Mid-Continent Neutral oil are given:

S. U. Viscosity of Blend 100°F.	300	500	750	1000
No. 7 Bright Stock 150 at 210°F.	16%	35%	48%	55%
Mid-Cont. Neutral Oil 200 at 100°F.	84%	65%	52%	45%

The Number 2 Oil classed as a Neutral has a Saybolt Viscosity of 200 at 100 degrees F., 0 degrees F. Cold Test, No. 2 N. P. A. color, good Demulsibility Test and a Conradson Carbon value of 0.03 per cent. While these specifications as such do not indicate any particular advantage over neutrals produced by other processes, it is certain that oils produced by this new process do not contain objectionable sulfur compounds produced by acid refining and the cost of manufacture is much lower than the usual oil of this class.

Fire Marshal's Association Adopts Accident Prevention as Part of Activity

Pittsburgh, Pa.—The Fire Marshal's Association of the National Petroleum Association meeting here January 12 was enthusiastically attended by its membership of refining company personnel, who are affiliated with the fire prevention work of the Eastern group of refineries. The third annual meeting of the Fire Marshals was characterized and dominated by a spirit of co-operative effort and good fellowship, and the frank interchange of knowledge and experience indicated that interested companies have again made a step forward in friendly co-ordination of effort.

The Fire Marshals' Association is unique in its work, not only in the petroleum industry, but in any other industry. Its members volunteer their services, and during the three years of its existance, the association has accomplished enviable results in the prevention of fire and in the training of men to combat fire intelligently. Fire fighting brigades have been organized and these groups meet regularly, usually each week, and inspect different refining plants in their respective districts for fire hazards, making recommendation for correction of any hazardous condition found. As a result of their diligent efforts throughout the past three years the majority of Eastern refineries are now greatly improved as to cleanliness and fire prevention equipment and knowledge of fire fighting.

The association at this meeting decided to carry out a campaign of accident prevention or safety first work in conjunction with its fire prevention activities. The association recognizes that while not every accident hazard is a fire hazard, every fire hazard is an accident hazard.

The association elected the same officers for the coming year that directed its activities during the past 12 months. James H. Herbert, Conewagno Refining Company, Warren, Pennsylvania, is president; James Sweeney, Viking Oil Company, Warren, Pennsylvania, is vice president, and S. R. Brown, Mutual Refining Company, Warren, Pennsylvania, is secretary and treasurer.

E. M. Lyons, president of the National Petroleum Association, addressed the meeting and commented upon the good work and scope of activities undertaken and accomplished by the fire marshals, and suggested that they also concentrate their efforts along the lines of safety and accident prevention. Mr. Herbert addressed the meeting, and endorsed the suggestion of the parent association that the fire marshals engage in accident prevention work. Mr. Sweeney read a paper on fire brigades and the organization of these groups in the individual refineries.

The meeting was addressed by Houston Dunn, secretary and treasurer of the National Petroleum Mutual Fire Insurance Company, Philadelphia, and among other things he pointed out to the fire marshals present the extreme value and the importance of their work and records, as a possible basis upon which insurance companies in the future may base rates applicable to refineries seeking fire insurance.

J. J. Forbes, United States Bureau of Mines, talked to the association on the subject of first aid work, and stated that the bureau would lend assistance to the fire marshals in giving first aid training to the men at the refineries.

H. N. Blakeslee, field representative of the Petroleum Section of the National Safety Council, then addressed the meeting on the subject "What the Fire Marshals Can Do in Accident Prevention."

Mr. Blakeslee stated that 21 men had been killed in the Pennsylvania oil industry during 1927. He said that a safety organization in a refinery could not work alone. It must have the support of the management.

A motion was made, seconded and passed to the effect that the name of this association be changed to the Association of Fire and Safety Marshals of the National Petroleum Association. Reports on the progress during the past three years were given by the chairman of each of the following groups. Warren, Bradford, Oil City, West Virginia.

The Budget and Its Place in Refinery Operation

By H. L. KAUFFMAN

WHILE most refining companies have some sort of a budget of expenditures, few carry the principle budgetary control to the point where a maximum benefit from the system is obtained. Companies which conduct business on a budget plan, in most cases, are now entering upon a new "budget year;" those *not* so doing, with the beginning of a new year and the tendency of human nature to make "New Year's Resolutions," undoubtedly will be interested at this time in the value of a budget as a means of controlling operations. So, too, many companies with a haphazard budget plan will probably find the discussion following some fundamental facts of immediate benefit.

Budgets for a new year, when January 1 is the beginning of a company's business year, are usually planned about September or October of the current year. However, in the refining industry a better practice, ordinarily, is to make a budget on the basis of a six-months' period of operation, in which case the interested executive can begin to plan now for his budget for the next six-months' period.

Any oil company that expects to progress—and this is particularly true of the refining branch of the industry—must sooner or later adopt budget control. An advantage of budgeting that is often not given full consideration is the fact that such a plan makes possible the measure of the efficiency of a superintendent, foreman or other person directly responsible for a particular phase of the business with a very close degree of accuracy. Here, too, it might be well to mention that budgets are drawn up partly from past experience and partly from what is *hoped for* rather than from what, necessarily, is *expected. Budget efficiency, then, is calculated by finding the difference between the actual departmental cost and the budget amount allowed*—thus making it possible to get an approximate measure of the capabilities of the person in charge. Although few oil companies practice the following suggestion, nevertheless in other industries it has been found a good plan to give a foreman or superintendent a reward according to the budgetary efficiency of that person's particular department or plant.

Lower Cost Possible

The budget is a means for accomplishing certain very definite results in the refining of oil, or of any business, provided the proper methods are adopted and followed. A budgetary plan of operation will tend to accomplish the following:

1. Reduce operating expenses.
2. Reduce sales, administrative and maintenance expenses.
3. Regulate the amount of oil refined with sales demand.
4. Regulate and reduce inventories.
5. Regulate and control bank loans and expenditures for capital account.

Almost all budgets in other industries are based upon the sales budget or quota. This would be a wise procedure for companies engaged in all branches of the oil industry to adhere to strictly; for, thereby, the tendency would be toward stabilization of prices in the industry, instead of the present relative instability where the amount of crude produced governs to too great an extent the quantity of oil refined, which practice results in large inventories of refined or semi-refined products when the sales demand is low. Let it therefore be repeated that the oil business as a whole would benefit by estimating refining budgets on a definite sales quota rather than on any other basis.

True enough, it is impossible in many more cases than it is possible to make an oil sales or volume forecast for the year that is not subject to fluctuations, either wholly or in part. Therefore, when the yearly forecast is broken down by months, or by any other period, in accordance with past experience as to the oil sales volume curve, it is generally necessary in drawing up the budget, as a practical matter, to narrow down the forecasting period to a shorter interval than the year. Most oil companies having budgetary control of operations in effect find a six-months' period preferable.

While the value of budgeting in the operation of refineries constitutes the main subject matter of this discussion, a few general remarks concerning budgetary control as applicable to management of a company engaged in the production, refining and marketing branches of the industry, probably, will not be out of order.

The adjustment and regulation of the budget should be centralized in the hands of the comptroller, chief accountant or treasurer, depending upon the lobical individual in the roganization and the type of organization. Such a person can then point out the variances and divergencies in each budget and call the attention of the person responsible for its control to these facts. The management, either through copies of individual budgets or through the master budget, as time elapses, is thereafter in a position to check up the actual with the estimated results.

The individual budget as set up is based largely upon past experience and certain fundamental relationships and, also, upon limiting figures obtained from knowledge of the sales quota for the year. In drawing up the budget, the management should give the refinery superintendent (who, in turn, passes as much of the information as is advisable on to other departmental heads under him) the general policy for budgeting and the fundamental relationships of the various factors to be considered, with their limits, for consideration and suggestions relative to setting up the individual budget. The budget of the refinery superintendent should be co-ordinated with the master budget and such adjustment made as subsequent comparison proves advisable to meet the requirements of the total or master budget.

To aid in meeting, or excelling, the budget for refinery operations, a good practice for the refinery superintendent to follow is to budget departmental expenditures, in the setting up and working out of which the full co-operation of the departmental head (whether foreman of the wax plant, acid plant, light oil treating department, or whatever the particular department of which that person is the head) is needed. It is to such of these foremen who operate their departments at lower unit costs than that estimated in the budget that the superintendent can well give financial rewards at the end of the period covered in the budget.

Object, Procedure and Advantages

The primary object of regulation by budgetary procedure, a matter of particular value in the operation of oil refineries is two-fold:

1. Promulgation and design of a predetermined plan of operation.
2. The execution of that plan, and the means of measurement, that is, of gauging the actual performance with the predetermined plan of operation.

Fordham and Tingley, in their book, "Organization and Budgetary Control in Manufacturing," emphasize the steps in the use of a budget, substantially, as follows:

1. The management determines the desired profit or attainable profit.
2. The comptroller:
   (a) Analyzes costs.
   (b) Analyzes markets.
   (c) Analyzes expenses.
   (d) Determines over-all sales quotas.
   (e) Allocates money per division.
   (f) Gives each division head his overall allotment. (Division head breaks this down and adjusts with comptroller.)
   (g) Compiles master budget from adjusted division budget.
   (h) Co-ordinates with sales demand.
   (i) Checks expenses and actual performance with budget.
   (j) Compiles monthly and quarterly

statements for management, showing the variances and deviations.

3. The management checks and regulates performance.

Fordham and Tingley state that the advantages of a budget, substantially, are these:

1. Forces pre-planning.
2. Requires centralized executive control.
3. Forces proper organization.
4. Brings about co-ordination of sales and production plans.
5. Helps eliminate peaks and valleys.
6. Increases and maintains operating efficiency.
7. Enables standardization of product, equipment, processes and methods.
8. Regulates inventories.
9. Permits costs to be used for standards and for regulation rather than as history.
10. Prevents unauthorized expenditures.
11. Enables financial planning and reduction of costs of capital.
12. Requires a study of expenses in advance, and their control and reduction.
13. Provides a definite goal.
14. Provides definite standards of comparison and of performance.

Budgeting Plant and Equipment Expenditures

To many executives the mention of "budget" brings to mind merely the budgeting of operating expenditures as a whole, and either less or no thought whatsoever is given to the matter of budgeting plant and equipment expenditures. However, in refinery operations especially, consideration to this phase of budgeting is of utmost importance and, hence, some general remarks applicable to the budgeting of expenditures for plant and equipment can well be made at this point.

Every superintendent knows that in order to keep his plant and equipment operating efficiently involves a large number of constant expenditures. These expenditures may be classified as follows:

1. *Repairs.* Expenditures for repairs are necessary to keep the plant and equipment in such condition that it can be operated efficiently.

2. *Replacements.* These are expenditures made to replace old equipment that is worn out and discarded. After a certain period equipment reaches the point where it no longer can be operated profitably and must be replaced by new equipment.

3. *Improvements.* These are expenditures for new patents and improvements to equipment, for lengthening the life of the equipment or for increasing the capacity or efficiency of the equipment.

4. *Additions.* These are expenditures for new equipment caused by the expansion of the business to take care of the increased volume of business.

In this connection attention is called to to the fact that if effective control over expenditures for plant and equipment is to be maintained by the plant superintendent, then the following is necessary:

1. A proper analysis must be made of each expenditure to determine its classification, and a record must be kept to show correctly its effect on the financial condition of the business.

2. A proper control must be exercised over the amount of the expenditures sufficient to provide a well-equipped and efficient plant and, at the same time, to prevent the expenditure of more than is necessary.

To exercise effective control over disbursements for plant and equipment, the following things are necessary:

1. Data must be available to show the results of past operations and to serve as the basis for future plans.

2. After all the available data have been considered, the plans that have been formulated must be expressed in workable form by means of a budget on plant and equipment. Here, let it be mentioned that sometimes two budgets are made, one on maintenance costs and one on the cost of improvements and additions.

3. After the budget has been completed, it is necessary to have records and reports prepared that will make possible the control of such expenditures and the enforcement of the budget plans.

The data required to serve as a basis for the control of plant and equipment expenditures may be obtained from the following sources:

1. The accounting and statistical records with reference to past experience.
2. Calculations based on predetermined factors.
3. The consideration of future plans.
4. The investigation and study of experts.

To control expenditures for plant and equipment, it is necessary to make, first, a proper classification for the plant and equipment and, secondly, an accurate estimate of plant and equipment expenditures. In petroleum refineries, plant and equipment expenditures will vary with the estimates as to the amount of oil to be refined. If sales of refined products increase to a point where more oil must be refined, then it may become necessary to do one or both of two things:

1. Secure additional equipment.
2. Use present equipment more extensively.

In either case additional expenditures will be incurred by the operation of the equipment, the capacity of which can be estimated without difficulty. For past production capacity to be obtained accurately, a record of each unit of equipment is necessary.

If the present equipment is to be used more intensively, this will increase the maintenance cost and an estimate of this increase must be made. It should be obvious that a change in the amount of oil being refined may not affect all the equipment of the refinery to the same extent.

Use of Plant Ledger

A plant ledger is a record that contains an account with each unit of plant and equipment. It serves as a subsidiary record to the controlling account or accounts with plant and equipment kept on the main ledger. The plant ledger is usually kept on loose cards or loose-leaf sheets, each card or sheet providing a record of one unit of equipment. The size of this unit will depend on conditions. There may be a separate account for each unit, or, if several pieces of equipment of the same pattern and size are purchased at the same time, (for example, Sweetland filter presses, refrigerating machines proper, etc.), they may all be recorded in one account. Each account in the plant ledger, however, should show four things:

1. The original cost of equipment and the date of purchase.
2. The amount of depreciations accrued on the equipment to date.
3. The amount of repairs made on it to date.
4. Its present book value.

The repairs entered on the plant ledger account do not affect the value of the equipment, since they are treated as an expense and are never added to the asset. However, it is useful to have such repair costs entered on the plant ledger account for memorandum purposes, so that in making future estimates it will be possible to obtain information of the past cost of repairs, not only in total, but also by departments and by units.

As equipment wears out, provision must be made for its replacement. This provision may be accomplished by charging a certain amount to the expenses of each budget period and crediting a like amount to a reserve for depreciation. In the calculation of the depreciation charge, three things are to be considered: (1) The original cost of the asset, (2) its anticipated life and (3) its estimated scrap value. By subtracting the scrap value of the asset from its original cost, it is possible to determine the cost of the use of the asset during its period of life. This cost is usually distributed over the period of life of the particular piece of equipment in such a way that each budget is charged with its equitable share. After the maintenance costs of past periods as shown by the accounting and statistical records have been obtained, it is necessary to determine the effect of future plans on these costs —a thing that may be done with no great difficulty upon making a careful analysis and study of all influencing factors.

It is desirable that a periodical inventory or appraisal be made of plant and equipment, same to be used as a means of checking the plant ledger and as a basis for budgetary plans. By this means inaccuracies in depreciation estimates and inadequate repairs can be discovered and corrected. It is also possible that too liberal depreciation may be allowed, or too extensive repairs be made, a condition that will be disclosed by a careful appraisal. Such an appraisal will show, also, when it is better to purchase a new unit or piece of refinery equipment rather than to repair an old one.

Formulating the Budgetary Plan

Formulating a plant and equipment budget involves a consideration of:

1. The preferred contents of the plant and equipment budget.
2. The responsibility for its preparation.
3. The form in which made.
4. The manner in which used.

Such a budget should state the following:

1. The anticipated repairs and estimated depreciation on the present plant and equipment.

2. The estimated cost of new equipment which, in turn, should show:

(a) Cost of refinery operating equipment.

(b) Cost of equipment for administrtive units of the business.

(c) Anticipated repairs and estimated depreciation on new equipment.

The refinery superintendent should be entirely responsible for the preparation of the plant and equipment budget. As has been mentioned in previous paragraphs, such a budget consists of an estimate of the expenditures necessary for maintaining the present equipment and the securing and the maintaining of the additional equipment demanded by the budget program.

Estimated Repair and Construction Costs

The estimate of the cost of repairs or construction can be made in two ways. If the business maintains an engineering department, this department can be asked to make the estimate. If it is not possible or not desirable to have engineers make the estimate, it can be made by the cost-accounting department on the basis of statistics obtained from the records showing previous costs. If co-operation between the accounting and the engineering departments is secured, more accurate estimates will be obtained. Estimating new construction costs is strictly a job for the engineer. The accounting methods used in connection therewith are familiar to every engineer and, hence, a discussion of same is considered to be beyond the scope of this article.

To exercise effective control over the plant and equipment budget, it is necessary to have periodical reports that will make possible a comparison between the amount appropriated for each class of expenditure and the actual amount expended. If the company is of such size as to have a "development department," then such a report can well be made by the engineers of that department; otherwise, this should be done by the resident or plant engineer or master mechanic, or by the refinery superintendent himself if the plan is of such size as not to have either a resident engineer or master mechanic.

It is especially necessary to discover the exact causes of failures to meet budgets and to record such facts so that the information may be used in determining the budget for the following period. Meeting the budget should be the goal for which all executives and department heads of an oil company aim, with full assurance that the goal is a fair one that can be met if constant pressure is exerted toward expense control consistent with maintaining the quality of the petroleum products as shipped.

While mention has not been previously made specifically herein, it should be noted that both the purchase of materials (such as fullers earth, caustic soda, sulphuric acid and other refining materials) and inventories should also be budgeted carefully. So, too, is it a wise procedure to budget accounts receivable and accounts payable as a necessary air in predetermining profits, which later indirectly is the main thing involved in budgetary control of refining operations.

Summary

Budgeting, as directly applied to the oil business, means further co-ordination between the producing, refining and marketing branches of the business. Projected plans in any division must be correlated with possibilities, probabilities and limiting factors known beforehand. Hopeful policies must harmonize with cold facts. Operations must meet requirements. Actual realizations must be checked back against expectations; and every activity creating expenditure must be proportioned according to its ability to add to revenues or to reduce costs and thus contribute a share of net profits.

Briefly summarized, the value, that is, the benefits of budgeting in the operation of oil refineries (or of any other business or particular branch of that business) are as follows:

More economical operation of the refinery is obtained through the study of expenses in advance, and setting up a definite program for expenditure consistent with the quantity of petroleum products that can be sold. A budget gives to the refinery superintendent and every departmental head a definite goal for attainment, all of which brings the competitive spirit into action and makes for better results.

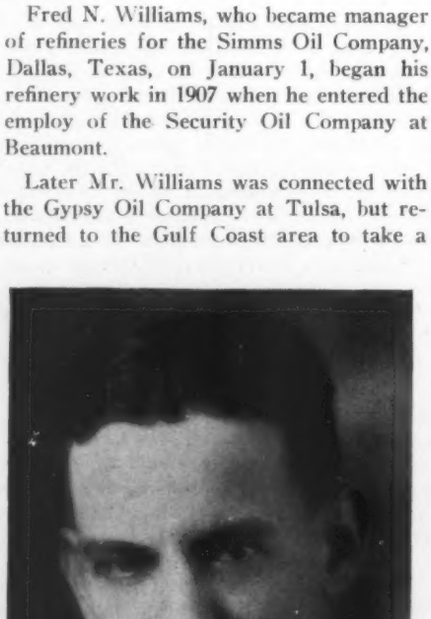
The budget is a fair measuring-stick for an individual's performance, varying as it does with activity and recognizing an executive's responsibility for expenditures. "Meeting the budget" then, gives the executive "pride in accomplishment," a thing of immeasurable, intangible value to the individual and, usually, recognized by the company by the giving of a tangible reward either in cash or in the form of a promotion.

Where budgetary control is practiced by the producing, refining and marketing divisions of an oil company, such an arrangement will cause to be avoided the possibility that one division of the company is destroying the profits of another division through unauthorized expenditures; and will tend to create a favorable, competitive spirit among the several divisions.

Williams—Simms Plant Man

Fred N. Williams, who became manager of refineries for the Simms Oil Company, Dallas, Texas, on January 1, began his refinery work in 1907 when he entered the employ of the Security Oil Company at Beaumont.

Later Mr. Williams was connected with the Gypsy Oil Company at Tulsa, but returned to the Gulf Coast area to take a position with the Gulf Refining Company in its experimental laboratory. After a year with the Gulf organization, he returned to the scene of his first activities, the plant then being under the management of John Sealy & Company—later to become Magnolia property. Here he was chief chemist and in charge of process.



FRED N. WILLIAMS
Manager Refineries, Simms Oil Company

Leaving the Magnolia in 1919, Mr. Williams went to Boston and built, and later became superintendent of operations of the Massachusetts Oil Refining Corporation. While here he designed a refinery for Boston interests for construction in Kentucky.

Finishing that work, he returned to Houston, doing consulting work, and was editor of THE REFINER AND NATURAL GASOLINE MANUFACTURER. In 1922, Mr. Williams designed and built the Oklahoma refinery of The Texas Pacific Coal and Oil Company. From this position he went to Shreveport as superintendent of the Gas Center refinery of the Louisiana Oil Refining Corporation. Later he was promoted to superintendent of the same company's Bossier City refinery, leaving this position to become associated with the Simms Oil Company, operating refineries at Dallas, Texas, and Smackover, Arkansas.

Mr. Williams is the author of many articles on refining for American and foreign trade journals, and is a member of a number of technical societies. He is a member of the British Institute of Petroleum Technologists, and a Fellow in the Royal Society of Arts.

Construction Details of Lubricating Oil Agitators

By H. L. KAUFFMAN

THE two main branches into which the refining of petroleum products naturally divides itself are, first, the refining of light oils, such as gasoline and kerosene; and, second, the refining of lubricating oils. The present article will be limited to a discussion of the refining of lubricating oils by chemical treatment and, particularly, to the construction details of the equipment required for carrying out the treating operation.

A short discussion of the operating procedures involved in treating lubricating oils will make more clearly understood later discussion of the details of construction of the equipment used in that operation.

In the distillation of crude oil the lighter products are first removed, and the lubricating stocks (both distillates and residual oils) from the crude are then further refined by chemical treatment, followed by a physical treatment, such as the filtration of the oil through a column of coarse-mesh fullers earth (percolation filtration); or, agitating the oil with finely-divided fullers earth or acid-treated clay (so-called "contact filtration".)

The chemical treatment consists, for the most part, in treating the oil with sulphuric acid, separating and drawing off the resultant sludge and neutralizing the treated oil with solutions of either caustic soda, soda ash or other alkalies.

The object of the refining process, and particularly the treatment of the oil with sulphuric acid, is to remove certain impurities in the oil that tend to diminish or even to destroy the chemical value of that oil. The chemical composition of these impurities is not definitely known, but, in general, it may be said that they are largely asphaltic and bituminous bodies containing varying amounts of sulphur, nitrogen and oxygen and having the ability to discolor the oil.

The detailed method of procedure for treating a lubricating oil varies greatly, for the process to be followed depends both upon the nature of the oil and the use to be made of it, and the character of the crude from which the oil undergoing treatment was obtained.

Ordinary Treating Methods

However, the essential operations involved in the treatment of an oil with sulphuric acid are about as follows:

Into the agitator is pumped the oil to be treated, after which the oil is allowed to stand for a short time and any water that settles out is then drawn off. If a considerable quantity of water is present in the oil when the main dosage of acid is applied, the increased temperature resulting from the reaction between the water and the acid will materially interfere with the successful treatment of the oil. For this reason, if the oil contains water, a small amount of acid, varying in quantity from one pound to five pounds per barrel of oil to be treated, is added to the agitator, the oil next being blown with air for a short time and then allowed to stand for at least three hours, preferably over night. The "settlings" are now drawn off, after which the oil is free from the presence of any great amount of water and is ready for the main acid treat.

The amount of acid to be used in the treatment of an oil depends both upon the character of the oil being treated (that is, the type of crude from which the oil was obtained, the narrowness of the fraction undergoing treatment, the viscosity or body of the oil and the amount of cracked products present therein) and the degree of refinement that is desired.

The acid is usually applied to the oil by filling a small tank and exhausting this by means of compressed air. In order to obtain a maximum efficiency from the quantity of acid used, it is more advantageous to add the acid in several "dumps," agitating, settling and drawing off the sludge after each addition of acid.

Knocking Down

Air agitation is generally used to mix thoroughly the oil and acid. Since either too long or too short a period of agitation is detrimental to the full success of the chemical treatment, practical experience in treating the particular product is almost essential for a maximum efficiency of results.

After the oil and the acid have been agitated together for the proper period, the sludge is "knocked down" from the acid-treated oil by sprinkling either cold water or weak solution of caustic soda or soda ash on the oil while, at the same time, agitating it very gently. This procedure gathers together the very finely-divided sludge particles until they are of such size and weight that they will become sufficiently heavy and compact to settle out of the oil.

After the sludge has completely settled out, the oil is transferred to a second agitator where it is neutralized with a solution of either caustic soda or soda ash or by means of other alkaline substances, thereafter being washed with hot water until all excess alkali has been removed. Tests of the oil are made with phenolthalein indicator to ascertain when all of the alkali has been removed.

Some refiners who have adopted the "contact process" of filtration depend upon finely-divided clay, which is used in "contact" filtering operations *after* the acid treatment, to remove the excess acid from the treated oil. Many refiners use ammonia for neutralizing their cylinder stocks. Numerous other processes are in use for "finishing" the oil after acid treatment.

The amount of sludge that results from the treatment of an oil with sulphuric acid will vary from as low as 3 per cent, in the case of sludge from the treatment of non-viscous lubricating distillates, to as high as 35 to 40 per cent of sludge resulting from the treatment of cylinder stocks.

With the foregoing general discussion of the operating procedures involved in the chemical treatment of lubricating oils clearly in mind, a discussion of the construction details of agitators and other equipment required for carrying out the treating operation will be more readily understood.

The lubricating oil agitators to be described are those in use at the Parco, Wyoming, refinery of Producers and Refiners Corporation. These agitators, and related heavy-oil treating equipment, were built by the J. G. White Engineering Corporation as part of the construction program in building the Parco refinery.

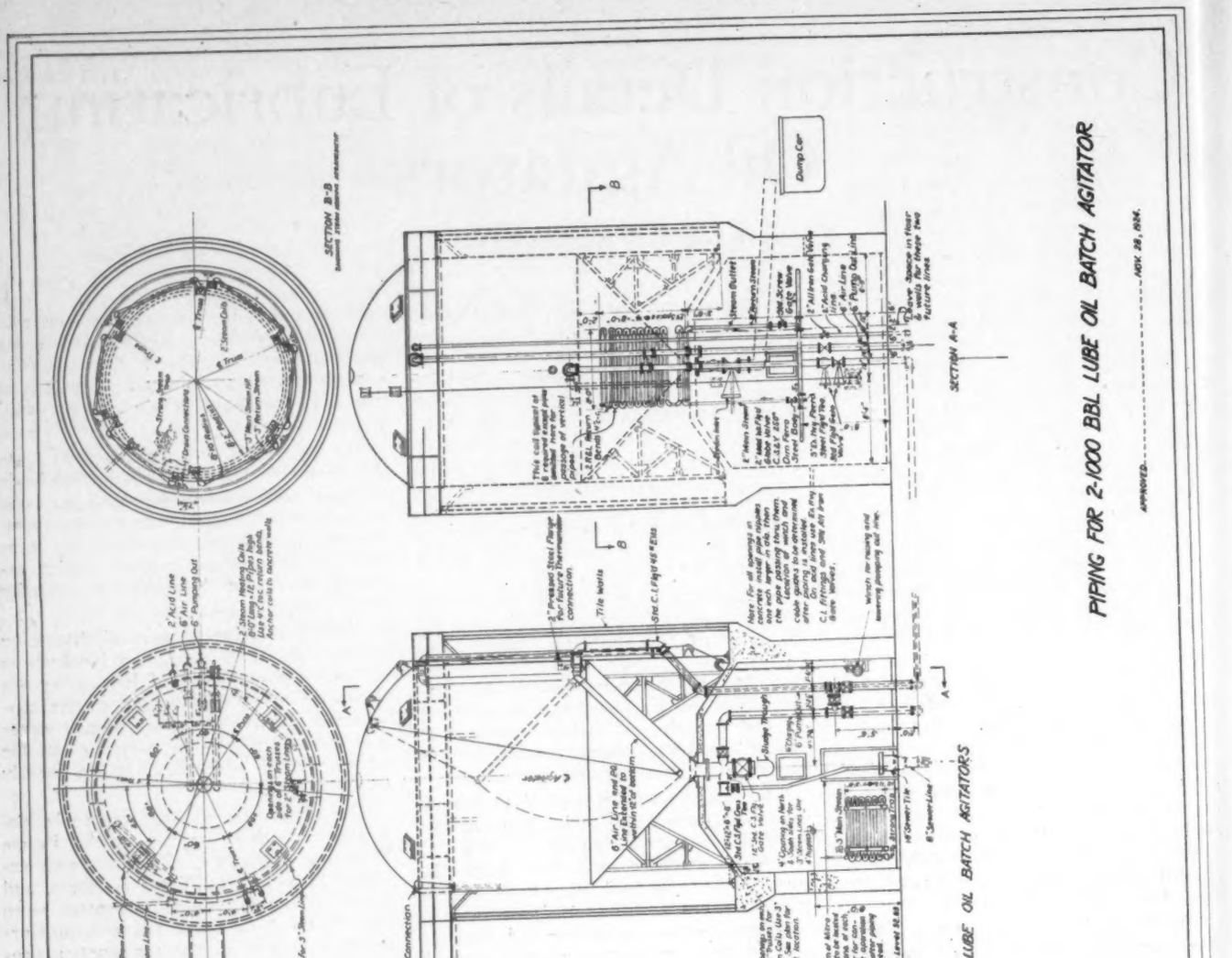
Two 1000-barrel lubricating oil agitators were constructed at this refinery and these, then, were connected by a walkway with two 1000-barrel light oil agitators that had previously been constructed. Both lubricating oil agitators are identical in construction.

Construction Details

At this refinery the lubricating oil, in most cases a "long residuum," is treated with sulphuric acid and then neutralized and decolorized simultaneously by "contacting" with "100-up" mesh Georgia or Florida fullers earth.

Construction details of the lubricating oil agitators built at the Parco refinery are shown in Figure 1. It is to be noted that each agitator is elevated to a height of 15 feet and that the agitator proper is insulated for the remainder of the height, a distance of 29 feet. The center of the dome of the agitator is five feet higher than that of the sides.

The agitator is un-lined with lead. It has an inside diameter of 20 feet, while the difference from the bottom of the cone of the agitator to the center of the dome is 30 feet eight inches. The cone makes a 45 degree slope, starting at a point 16 feet from the top (side) of the agitator. The diameter of the opening at the bottom of the cone is three feet, the opening being further reduced (on the lower side of the concrete support) to 12 inches, at which point the "draw-off" is fitted


PIPING FOR 2-1000 BBL LUBE OIL BATCH AGITATOR
SECTIONAL ELEVATION OF LUBE OIL BATCH AGITATORS
PLAN
SECTION A-A
SECTION B-B
RECORD OF ISSUES AND REVISIONS

with a 12-inch standard gate valve. The cone of the agitator is braced by steel trusses.

An opening one foot six inches by two feet six inches in size, is provided in the concrete base through which a sludge chute passes. Two doors are also provided for entrance to the base.

Insulation

An air space two feet four inches wide, surrounds the agitator. Next is a four-inch layer of sil-o-cel brick, while the outer layer consists of Silo tile, also four inches in thickness.

Below is shown a "rod list" of the steel bars used in the construction of these two agitators at Parco:

ROD LIST

Mark	Number	Diameter in inches	Length	Remarks
a	96	⅝	10′0″	.....
b	170	"	12′0″	.....
c	24	½	5′3″	Straight
d	24	"	7′3″	.....
e	125	"	18′6″	.....
f	66	"	16′0″	.....
g	125	"	4′0″	Straight
h	16	¾	4′0″	Straight
k	60	½	19′0″	Bent to 10′6″ Radius
m	40	"	17′0″	Bent to 9′10″ Radius
n	20	"	19′0″	Bent to 12′8″ Radius

All concrete footings for these agitators were made to extend down to good bearing on firm ground, a minimum depth of four feet being specified. The concrete composing these footings consisted of a 1:2½:5 mixture, whereas all other concrete used throughout the construction of these agitators consisted of a 1:2:4 mixture. The maximum bearing pressure of each agitator on the soil is 4000 pounds per square foot.

All concrete surfaces in contact with the ground were thoroughly coated with "Aquadam" paint. All re-inforcing steel used throughout consisted of round, deformed bars. All reinforcing bars were lapped at intersections for a minimum of 40 times the diameter of the bar. All bars were bent around openings.

Piping

The essential piping layout for these two lubricating oil agitators is also shown in Figure 1. The lines for each agitator include:

One 6-inch charging line.

One 6-inch "pumping-out" line. (The oil is pumped out of the agitator by means of a swing line that can be raised or lowered from the top of the agitator.)

One 2-inch acid line from the acid blow cases.

One 6-inch air line from the air compressor.

One 2-inch steam-smothering line.

One 3-inch, high-pressure steam line to heating coils, which are placed against the cone of the agitator for heating the oil.

Two 1½-inch foamite solution lines.

One 6-inch sewer line (buried) which, in turn, connects with a 10-inch sewer line, also buried.

Acid Storage Tanks

Four eight-feet diameter by 25 feet long acid storage tanks are in use at the Parco refinery for storing 66 degree gravity Baume surphuric acid. These tanks are provided with a 20-inch manhead opening, controlled by a one-inch stem rod leading to the top, this bottom opening being fitted with a two-inch, 30 degree conical outlet plug and a special forged steel outlet flange.

These tanks rest upon concrete supports and convenient walkways lead over the top of same.

They were bought under the following purchasing specifications:

Dimensions—All dimensions to be true and in accordance with the drawing.

Material—Shall conform to the Association of American Steel Manufacturers' standard specifications for plates and rivets.

Rivets—All rivets to be open-hearth, class "C" steel.

Steel—All plates and heads to be open-hearth, class "A" steel.

Rivet Holes—Rivet holes to be punched 3/16-inch less than full diameter of rivet and then drilled or reamed to a finished diameter of not more than 1/16-inch larger than the rivet with plates and heads bolted in position. After drilling or reaming the rivet holes the plates and heads shall be separated and the burrs removed. Ribets shall be of sufficient length to completely fill rivet holes and form heads equal in strength to the bodies of the rivets.

Riveting—Girth joints to be single riveted lap joints—11/16-inch, 1-13/16-inch pitch, 1-1/8-inch gauge. Longitudinal joints to be double riveted lap joints—11/16-inch rivets, 2-7/16-inch pitch, 1½-inch pitch of rows, 1-1/8-inch gauge.

Caulking—All caulking edges shall be beveled, sheared or planed for caulking. Caulking shall be done with a round-nosed tool. The joints shall be made acid and air tight by caulking only. No foreign matter shall be used in joints. Shell to be caulked inside and out. No caulking of rivets allowed.

Testing—Tank to be made absolutely acid tight. It is to be tested by filling tank with water and must withstand a hydrostatic pressure of 50 pounds per square inch.

Painting—In the shop the metal shall be cleaned of dirt and scale and the outside surface shall be given a coat of graphite and oil. After being completed, caulked and tested, the outside surfaces shall be given another coat of graphite and oil well worked into the joints and open spaces.

Workmanship—All workmanship to be first class. The plates shall be formed cold to exact requirements after punching and beveling. Drift pins shall be used to bring the parts together. Drift pins shall not be driven with enough force to deform metal around holes. Riveting shall draw the joints to a full and tight bearing.

Shipping—Tanks to be shipped assembled complete as per this drawing.

Duty—Tanks to be used for storing 66 degree Baume sulphuric acid.

Drawing—Shop drawings to be submitted to the J. G. White Engineering Corporation for approval.

Inspecting—The manufacturer shall furnish all facilities for inspecting and testing, but passing by the inspector does not relieve manufacturer of responsibility for defective material or workmanship.

Acid Blow Case

Two three feet six inches diameter by nine feet long acid blow cases are in use at this refinery in blowing the acid upon the oil to be treated. These blow cases are provided with a 16-inch manhead with cover; a three-inch opening for a line (leading to the bottom of the blow case) that connects with the acid line leading to the agitator; a two-inch opening for an air connection; a two-inch opening for a filling line; and another two-inch opening for a gauge and vent.

The two acid blow cases were bought under the following purchasing specifications:

Dimensions—All dimensions to be true and in accordance with the drawing.

Materials—Shall conform to the Association of American Steel Manufacturers' standard specifications for plates and rivets.

Steel—All plates and heads to be open-hearth, class "A" steel.

Rivets—All rivets to be open-hearth, class "C" steel.

Riveting—Girth of joints to be single riveted lap joints—15/16-inch rivets, 2-½-inch pitch, 1-⅝-inch gauge. Longitudinal joints to be double riveted lap joints—15/16-inch rivets, 3⅛-inch pitch, 2-inch space of rows, 1½-inch gauge.

Rivet Holes—Shall be punched 3/16-inch less than the full diameter, and drilled or reamed to a finished diameter of not more than 1/16-inch larger than the rivets with plates and heads bolted in position. After drilling or reaming the rivet holes, the plates and heads shall be separated and the burrs removed. Rivets shall be of sufficient length to completely fill rivet holes and form heads equal in strength to the bodies of the rivets.

Caulking—All caulking edges shall be beveled, sheared or planed for caulking. Caulking shall be done with a round-nosed tool. The joints shall be made acid and air tight by caulking only, no foreign matter shall be used in joints. No caulking of rivets allowed. Shell to be caulked inside and out.

Testing—Shell and heads to be tested to 150 pounds hydrostatic pressure.

Painting—In the shop the metal shall be cleaned of dirt, rust and scale and the outside surface shall be given a coat of graphite and oil. After being completed,

caulked and tested, the outside surface shall be given another coat of graphite and oil well worked into all joints and open spaces.

Workmanship—All workmanship shall be first class. The plates shall be formed cold to exact form after punching and beveling. Drift pins shall be used only to bring the parts together. Drift pins shall not be driven with enough force to deform the metal around the holes.

Inspection—The manufacturer shall furnish all facilities for inspecting and testing, but passing by the inspector does not relieve manufacturer of responsibility for defective material or workmanship.

Duty—Blow cases to be used for blowing concentrated sulphuric acid into acid treating agitators.

Drawings—Shop drawings to be submitted to the J. G. White Engineering Corporation for approval.

Shipping—Blow cases to be shipped assembled. All pipe lines used in transferring acid at the Parco refinery are of extra heavy iron pipe and all fittings are of extra heavy malleable iron. All valves are standard, all-iron, clip gate valves and all valve stems are packed with commercially pure asbestos rope packing.

The air compressor in use at the lubricating oil agitators of the Parco refinery is a 10-inch by 17-inch by 12-inch Worthington "Laidlaw," single, horizontal, enclosed, self-oiling, steam-driven, feather-valve compressor with piston steam valve; and further provided with a combined steam and pressure governor, steam throttle valve, lagging on steam cylinder, sight-feed lubricator for steam and air cylinders and an oil gauge for indicating the oil level in the crankcase.

This compressor has a displacement of 750 cubic feet per minute at 240 R.P.M. and has a volumetric efficiency of 86 per cent. Sixty-two horsepower is required to drive the compressor, which has a steam consumption of 28 pounds per horsepower when operating with 145 pounds steam pressure against atmospheric exhaust, 100 degrees F. superheat, 30 pounds air pressure.

Chemistry for the Treating Plant Operator

By L. J. CATLIN
The Standard Oil Company (Kansas)

CHEMISTS, Ahoy! The secrets of our craft are getting out. Our mystic lauguage and terrifying passwords are being used openly by those who have not come up through classic halls, nor gone groping through drowsy lectures and smelly laboratories. Men and women, girls and boys, business men and laborers, ministers and congressmen. No class seems exempt. A discussion of electrons is considered a part of the evening's entertainment; vitamin, is a household word; and in the oil business we begin to hear conversations about mercaptans, olefins and aromatics, where formerly crude oil could be completely described in terms of paraffin and asphalt base, and treating plant operations fully explained by saying it "took the carbon out of the gasoline;" and it is rumored that in one of the New England refineries an assistant superintendent has been found who distinguishes plainly between sulphide and sulphate without putting a pebble under his tongue.

The reasons for this state of affairs are not difficult to find and when followed to its source it is not to uncover any clandestine practices, but the information is found to be emanating from the very holy of holies of our profession, and sanctioned by those "higher up." And most of us must confess that we knew it all the time. We are also aware that there are those, both within and without the profession, who say it is all propaganda with ulterior motives, even financial gain; a sort of advertising, as it *were*, for chemists. Neither are we to deny or confirm, commend or condemn this view of the question, but prefer rather to herald it as at least one sign of intelligence, and proof that the profession is becoming *practical*.

After all why should this not be true? Why should chemistry be the last of the engineering professions to invite familiarity, or why should its language be excluded from polite conversation? For we submit to any intelligent, fair-minded person that "mercaptan" is no worse a word than "carburetor," yet who was ever perplexed by a carburetor? The mechanic meets doubters merely with the statement and gesture that "there it is," and no more questions are asked and perhaps it is well that they are not. The chemist, however, sometimes has a little more difficulty proving his statements, for it has been definitely proven by doctors of education at Columbia University that many of the things we learn come to us by way of the visual organ, sometimes called the eye; and some of the things talked about are not easily seen. In spite of this fact, we still maintain that it is foolish for a car driver to have his car treated for carburetor when the trouble is differential, or for either of these when he is merely out of gas. Likewise, it is foolish for the treater of petroleum distillates to treat an oil for mercaptan when it has only hydrogen sulphide, or for either of these with a chemical that is exhausted for that particular reaction.

AT THE AGITATOR

It is the common thing to write of chemistry in the language of the man in the laboratory.

But the man at the agitator should know the reasons for the reactions of the chemicals he uses. Finding literature written in his language is difficult.

Here is an article that takes the chemistry of treating out of the laboratory and puts it at the agitator, where it belongs.

The author aptly says, "mercaptan is no worse a word than carburetor."

Just Plain Talk

The title of this paper, as well as the introductory paragraphs, are meant to throw down a challenge to the editor to either make some of these things plain and discernible to the average non-chemist, or dump this paper in the waste-basket. We leave it to our worthy editor to judge and decide, taking due thought for space and ink expenditure. That should leave sufficient alibi for all concerned, no matter what the outcome.

We may say further that the subject matter of this paper is not essentially different from that which has appeared in numerous publications within the last two years on the question of treating distillates. The sole excuse for this attempt being a different point of view—that is, that of the man on the job at the treating plant, or responsible for its operation. In other words, we will try to segregate and visualize some of the things which have formerly been described by chemical formulas.

Let us assume that we have a distillate which is to be prepared to pass the regular specifications for gasoline or kerosene. From the standpoint of the treater we are to determine the quickest and cheapest method which will attain that end. The principal specifications which interest us are the following:

1. It must be sweet by the doctor test.
1. It must pass the color test if a finished product.
3. It must pass the copper strip test.
4. It must pass the test for total sulphur prescribed for its class of product.
5. It must pass the gum test, if gasoline.
6. It must pass the burning test, if kerosene.

There may be others, but perhaps we have already bitten off more than we can chew, so will keep these points in mind in the following discussion.

Let us first consider sweetening. In many cases that is all that is required. For practical purposes the treater needs to consider just two kinds of sourness—

hydrogen sulphide and mercaptan—and it is very important that he be able to distinguish between these. Two simple tests will indicate the relative amounts of these two impurities. First, test the oil for hydrogen sulphide by shaking it in a bottle with a solution of lead acetate. This can be made up by adding about a teaspoonful of lead acetate (sugar of lead) to a quart of water, then adding just enough acetic acid to make the solution clear. If distilled water is used less acid will be required. If hydrogen sulphide is present in the oil a black precipitate will form at once on addition of lead acetate solution.

This test in no way affects the mercaptans. To test for mercaptans first remove all the hydrogen sulphide from the sample as just described, and filter the oil to remove all cloudiness due to washing with the lead acetate, then add doctor solution and sulphur as in the regular doctor test. A yellowish color gradually turning to orange or brown, indicates mercaptans, and you have now *seen* the mercaptan reaction with all other interfering reactions out of the way. If no reaction takes place with doctor it is obvious no mercaptan is present.

What to Do About It

Now for the interpretation of these tests as related to treating methods. We have already said we want to treat as cheaply as possible, which simply means getting rid of the hydrogen sulphide and mercaptan, each with as little chemical and time as possible, consistent with the desired results and in most cases this can be accomplished best by taking them one at a time.

First consider hydrogen sulphide. This is a gas and merely dissolved in the oil. If treating a heavy distillate not subject to excessive evaporation loss, it can be almost completely removed by blowing with air. This must be used cautiously, however, because of the extremely poisonous character of the gas when breathed. Washing with water will largely get away from this danger, and washing with caustic solution eliminate the danger, but increases expense. Hydrated lime is perhaps the cheapest chemical that can be used for removing hydrogen sulphide if handling expense is not excessive, but its solubility is so low that stirring devices are a necessity in order to keep the lime in suspension for pumping. Next perhaps comes caustic soda, and all things considered, perhaps cheapest. The most expensive chemical, and yet one too frequently used, is doctor solution; for in this case the chemical consumed is litharge.

The reason for removing hydrogen sulphide before adding doctor is now obvious. Litharge should be used solely for reacting with mercaptan, but if hydrogen sulphide is present it reacts with it by preference and the mercaptan reactions connot begin till all the hydrogen sulphide is removed. By this time perhaps all the lead, or litharge, is removed and the oil still sour. The relative costs of removing 100 pounds of hydrogen sulphide by the three chemicals just mentioned are approximately as follows: hydrate lime, $1.11; caustic soda, $5.76, and litharge, $66.90. This is, of course, figuring only the cost of chemicals exclusive of handling and not assuming any recovery value. In the case of litharge there is a recovery value either by sale to lead companies as sludge, or by the more recently developed art of blowing with air and heating, to effect solution in the form of doctor again. In either case recovery will not exceed 75 per cent of the value of the litharge, leaving a net cost of $16.75 for comparison with the above figures.

One more point is important in connection with the use of any chemical for the removal of hydrogen sulphide, and that is, that we get full use of the chemical, as well as complete removal of the hydrogen sulphide. We may fail in this respect from various causes, chief of which is insufficient contact between oil and chemical. The time required is very small if contact is good.

A recent experience illustrates the point. Caustic soda was being used in a mixing column with gasoline in a closed system, and while the caustic solution was only being half spent the gasoline still contained a large amount of hydrogen sulphide. Changing the design of the column to give better mixing, permitted running the caustic 100 per cent spent and all the hydrogen sulphide removed. Obviously the quantity of caustic for a given result was reduced one-half.

Checking Up

The next question is how to tell when the chemical is completely spent. The test for this was given in a previous paper on this subject, but is, perhaps, worth repeating here. Collect a sample of the caustic (the same test may be used in the case of hydrated lime) and filter clear of oil by passing through a paper moistened with water. Take from 30 to 60 drops as it comes from the funnel, depending on whether the solution is high or low gravity, in a breaker and add one drop of phenolphthalein indicator, which gives a red color. Now add dilute sulphuric acid from a burette until one drop makes the solution clear. Take the reading on the burette. Now add one or two drops of methyl orange indicator which gives the yellow color and again add sulphuric acid till the yellow color changes to orange, or pink. If the second, or total, reading is just double the first the caustic is 100 per cent spent. Or to find any other percentage, subtract the first reading from the second or total reading, and multiply the difference by two. Divide this result by the second or total reading. The result multiplied by 100 gives the per cent spent. On this basis it is possible for the reaction to go to 200 per cent, but the limit for practical use is 100 per cent. Any amount over 100 per cent is, of course, all right if the oil tests free from hydrogen sulphide, but a result very much below 100 per cent indicates needless waste of caustic, either because of excess, or poor mixing. The sulphuric acid for this test is made by adding about five cubic centimeters of pure acid to a quart of distilled water. With a little practice it doesn't take much longer to make these tests than it does to tell about them.

We are now ready for the mercaptan, which is the real doctor reaction. If, on the addition of doctor to the oil, a black precipitate forms immediately, it is a pretty sure sign that hydrogen sulphide is not all removed. If the oil sample is taken before it has had plently of settling time a precipitate may be due to spent caustic carried over. If filtering will prevent this, it is quite certain that sufficient settling time will also effect its removal. For the reaction with mercaptan two things are necessary—litharge, or lead, in doctor solution; and sulphur, either in solution in the oil or added as flowers of sulphur. And for a definite amount of mercaptan there will also be required a certain definite amount of lead and sulphur. There are no short-cuts to a complete reaction with mercaptan. Whenever lead and sulphur are present in sufficient quantity the reaction will be completed in a very short time and the oil will be sweet.

One very important warning is, however, necessary at this point. An excess of lead will not hurt anything, because it will remain in solution in the doctor and be recovered, but an excess of sulphur will remain in the oil and show up as corrosion in the copper strip test, or spoil the lamp burning test for kerosene, or cause a high test for total sulphur at the laboratory. Hence sulphur must be added cautiously and only in an amount absolutely necessary to complete the reaction to the point of the "break" or settling of precipitate from the mercaptan reaction. One other warning becomes quite pertinent when sweetening the so-called "high sulphur" oils, and that is, that a completed reaction as indicated by the oil settling clear, does not necessarily mean a sweet oil. If the oil tests sour after settling clear, it is a sure sign that the lead is all gone from the doctor and more must be added before any further reaction on the mercaptan can take place. If air blowing is used in this connection it will tend to restore some of the precipitated lead to solution, but if much mercaptan remains to be removed the time and evaporation factors make it prohibitive and you may as well add litharge first as last.

After the Mercaptan

We are now ready to outline a testing procedure by which the operator may tell easily, and exactly where he is with the doctor-mercaptan reaction.

Take a sample of the oil after doctor has been added and thoroughly mixed, and consider it in the light of the following possible cases:

Case 1. The oil is clear and sweet by the doctor test. Make the copper strip test (described later). Darkening of the polished copper strip indicates too much sulphur. If no darkening shows on the strip, get someone to congratulate you; the treated oil grades 100 per cent.

Case 2. The oil is clear, and sour. More lead is required. Add more doctor, or speed up the pump, or add more litharge to the doctor already in the sys-

tem, as the case demands. A clear oil always indicates that sufficient sulphur has been added for the amount of lead reacting, although in this case adding more lead may also necessitate adding more sulphur.

Case 3. The oil is colored yellow, orange or brown and cannot be filtered clear. More sulphur is needed. Add a large excess of sulphur to the sample and shake till it settles clear readily. Test the clear oil with doctor. If it is now sweet, sulphur is all that is needed in the treating; if sour, both lead and sulphur must be added.

Case 4. The oil is colored, but will filter clear. This indicates that it will also settle clear if given sufficient time. Test the filtered sample by the usual doctor test. If sour, more lead is required; if sweet, test with the copper strip for excess sulphur. In this last mentioned case you are likely to find a simple standard by which to judge concerning the proper amount of sulphur to be added. When a sample settles rather slowly, but definitely clear, or filters clear, it is not likely to show excess sulphur and on the other hand most surely has enough.

One important relation if understood, helps to control the use of sulphur, i.e., it can go no further in the reaction than lead has gone with its part, but can at any time be utilized in that amount which is equivalent to the lead already involved. In other words, you can clear up the oil at any point in the reaction merely by adding enough sulphur to precipitate the lead already reacting. Whether or not the mercaptan is all removed, depends then entirely upon whether sufficient lead was present to react with all of it.

The copper strip test mentioned above is another test that needs to be followed up by the operator. A sample of the treated oil is filtered to make sure that it is free from moisture, and placed in a hot water bath at about 200 to 212 F. A polished strip of copper is placed in the oil so that about half of it is submerged and left for a half hour. If the submerged portion shows any darkening as compared with the uncovered portion it indicates too much sulphur used in the doctor-mercaptan reaction. The hot water bath may be kept in readiness by putting a small steam coil in a suitable container for the water. Four-ounce bottles, or test tubes obtained from the laboratory, are properly supported in this bath for sample testing. This is not the official test as prescribed in Bureau of Mines Bulletins, but is sufficiently accurate for operating purposes.

As far as color is concerned, there is nothing in the sweetening reaction, properly carried out, that should materially change the color unless it be to improve it. If doctoring throws the oil off color the explanation must be sought in something aside from the doctor-mercaptan reaction. Cracked distillates contain cresols which dissolve in caustic solution and hence may accumulate in the doctor. Much of the yellowish, or brown color of used doctor comes from that source. When caustic becomes saturated with cresols it can no longer take them from the oil, though in other respects the doctor may still be good; and it may begin giving them back to the oil, even in an intensified form. This is especially true where the practise of heating and blowing doctor is used for restoring the lead precipitate. As much as 1 or 2 per cent of cresol in caustic solution will give it a brilliant wine color when heated and blown with air. For this reason where doctor is to be restored by air blowing it is necessary to segregate the doctor used on cracked distillates from that used on finished stock.

Doctor used on straight-run distillates may be restored indefinitely without color troubles. Where distillates are to be rerun, as with steam still stocks, it does not matter if the doctor does becomes colored, so long as its other reactions are not interefered with. Heavy motor distillate obtained in rerunning treated cracked distillates may also be handled the same as straight-run distillates, because the cresols have a boiling point above 400 F. and do not come over appreciably in this stock. They will, however be found in kerosene stock from this source. They are, of course, removed by doctoring or caustic washing, but if the caustic solution is to be used again in this system it must have its lead added as litharge and not by heating and airblowing.

Lead in the Doctor

One more simple test, available to the treater may often be of service in connection with doctoring, and that is a test for lead in the doctor. The tests already described for the oil will give an indication as to the condition of the doctor with respect to lead, but this may be followed up by taking a clear sample of the doctor and adding it to a solution of sodium sulphide, which will give a black precipitate with lead. This sodium sulphide may be found in the caustic solution that is used for the removal of the hydrogen sulphide. If the doctor solution is not clear it should be allowed to settle, if possible, instead of filtering, because filtering removes part of the lead from a doctor solution. If filtering is necessary, allow about 50 c. c. to pass through the filter before collecting the sample for testing. Quantitative tests for lead in the doctor may best be left for the laboratory, but several such methods have been proposed which could be used by the treater if desired.

So much for the doctor treatment. To check up on our proposed specifications, the oil should now pass the doctor test, the copper strip test, and be at least as good color as when it came to the treater, and if hydrogen sulphide was present in the original sample, it should now how less total sulphur. However, if the main portion of the total sulphur was in the form of mercaptan it will probably not be much improved; for although mercaptan is a sulphur compound, and reacts with doctor, it is not actually removed from the oil by doctoring, but merely changed to a less obnoxious form, and permits the oil to pass a test required in most specifications for finished products. To actually reduce the content of sulphur in the mercaptan form requires acid treatment, and in the case of "high sulphur" oils, perhaps fuming sulphuric acid. The test for total sulphur is strictly a laboratory test and need not be described here.

No Best Method

The reactions with sulphuric acid are not so easily followed by the operator as those with doctor, because the chemistry of this reaction is not so well known. In the case of straight-run products of high sulphur content, the standard for judging will probably be total sulphur in the treated stock. In the case of crack distillates the standard will be somewhat different. According to present standards the correct treatment with acid can probably be stated as that which will give color stability and freedom from gum in the finished stock, without unnecessary loss in volume and anti-knock properties. Needless to say these are beyond the testing facilities of the plant operator. Recent papers indicate important developments along the line of low temperature treatment and acidity control, but as yet no *best method* can be stated for all conditions, nor any simple tests be outlined to guide the operator, aside from gravity of acid and pounds per barrel, or perhaps the amount of acid heat produced. It is to be hoped that the next few years will see as much progress along the line of workable information on acid treating as the past two or three years have brought along the line of doctor treatment.

One thing seems certain, and that is that the final word in treating economy is the inventory sheet which shows materials used, and the more nearly the control methods can be put into the hands of the man who handles these materials, the better the chances for economy.

The author wishes to acknowledge his indebtedness to those who in recent years have published so freely the results of research in the chemistry of treating plant operation, and below is given a brief bibliography of helpful articles for anyone wishing to read further on this subject.

Wendt and Diggs—Ind. & Eng. Chem., Vol. 16, No. 11, Nov. 1924.

Wood, Lowy and Faragher—same issue as above.

Brooks—Ind. & Eng. Chem., Vol. 16, June, 1924.

Morrell and Faragher—Ind. & Eng. Chem., Vol. 19, No. 9, Sept., 1927.

Brooks,—Ind. & Eng. Chem., Vol. 18, No. 11, Nov., 1926.

Wood, Sheely and Trusty—Ind. & Eng. Chem., Vol. 18, No. 2, Feb. 1926.

Ginsberg—The Refiner, Aug. and Sept., 1926.

The Refiner & Natural Gasoline Manufacturer., Vol. 2, No. 7, July, 1923.

Morrell and Egloff—The Refiner & Natural Gasoline Manufacturer, March, 1927.

Klemgard—The Refiner & Natural Gasoline Manufacturer, May, 1927.

Halloran — The National Petroleum News, Dec. 14, 1927.

Morrell—Ind. & Eng. Chem., July, 1927.

One Fractionating Column Handles Vapors from Six Stills

By GEORGE REID
Associate Editor

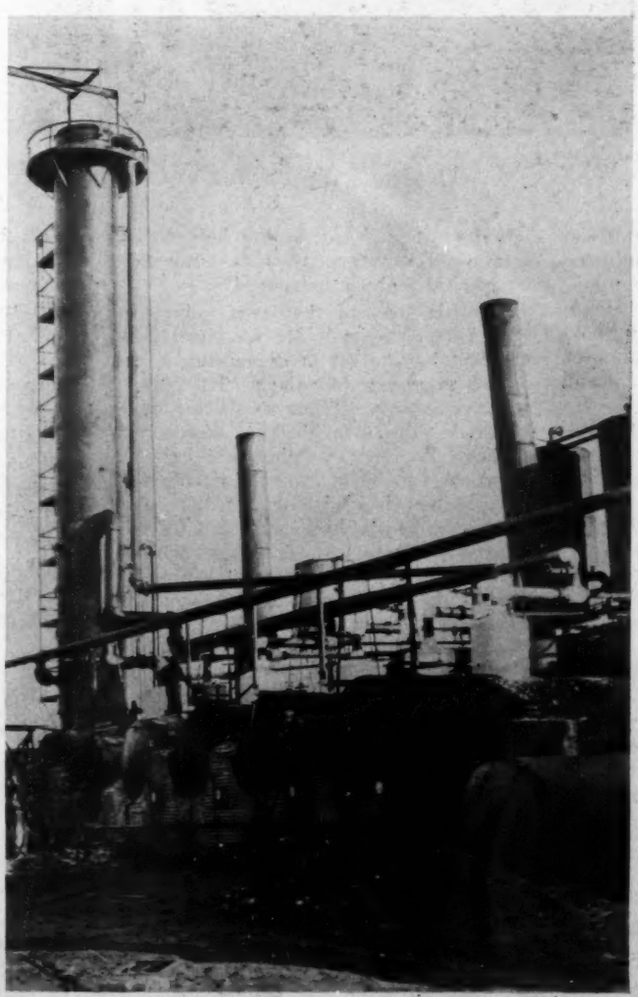
DURING the past few months the Root Refineries, Inc., has been reconditioning and improving the company's refinery at El Dorado, Arkansas. Included in the program of imporvement was the installation of a large and efficient bubble type fractionating column which handles the vapors derived from the distillation of Smackover crude oil in six shell stills in series.

The design or hook-up of these six shell stills in such a manner that one tower fractionates the vapors from them all simultaneously, is probably unique in the refining industry. So far as vaporization and fractionation of the vapors are concerned the results secured are identical with the usual installation of tubular retort and multiple-stream tower. Company executives lay no claim to similar fuel efficiency to that obtained in the tube still, but neither did they desire to dismantle their battery of shell stills constituting the skimming plant, just at this time. It seems that there are certain advantages in handling Arkansas crude, which bears some salt and other foreign substances, in shell stills, which may not be offset by the higher efficiency of the tube still. Also, the tube still, when operated on such crude oil is subject to frequent cleaning. Taking these and other problems into consideration, it was decided that the Root Refinery would be converted into the latest type of modern efficient installation, so far as fractionation is concerned, but that it would retain its old battery of stills, run them in continuous series as before, and handle all of the vapors derived from these retorts in one common tower.

Through the changes in operating methods and the installation of the new fractionating equipment the plant capacity has been increased from around 2200 barrels to the present capacity of 3500 barrels daily, using the original distillation equipment. In addition, plant efficiency has been improved and whereas former methods of operation yielded 10½ per cent of gasoline fraction from the crude, the plant now produces 14 per cent gasoline through the large tower from the same crude. An additional 38½ per cent of gasoline is derived from the crude through the operation of Dubbs cracking units, which brings the over-all gasoline yield for the plant to 25.5 per cent— and this derived from a crude oil running from 20 to 21 degrees A. P. I. gravity.

Photographs accompanying this discussion illustrate something of the design and layout of the refinery. The six shell stills shown are operated in continuous series in such a manner that all of the vapors coming from the first five stills are delivered into the tower, at about its middle—through a common vapor line. This vapor line is graduated or "telescoped"—being part six-inch, then enlarged to eight-inch, and then to 12-inch at the point where it begins carrying the largest volume of vapors, and enters the tower at the latter dimension. Thus, crude entering No. 1 still from the heat exchangers is heated further and stripped of a portion of its vapors, flowing into No. 2 still, and so on through the system to and through the fifth still in the series. Each still is carried at a higher temperature than that preceding it. When the vapors are driven off of the No. 5 still, the crude oil has been subjected to sufficient heat to vaporize all of the gasoline, and down to the gas oil fraction. All of these vapors are carried away in the common vapor line to the bubble tower.

In the tower these vapors rise upward, flowing counter-current to the condensate of gas oil passing over the trays which comes from oil previously vaporized in the stills. No recycle media is pumped through this upper portion of the tower. Vapors leaving the top of the tower are conducted to Sterling condenser sections and condensed as gasoline having a final boiling point around 437 degrees F. The reflux condensed in the upper section of the bubble tower as described is collected at the bottom of the section or compartment, and conducted away through cooling coils and to storage. This material has an initial boiling point higher than the end point of the gasoline stock taken over-head off the tower.



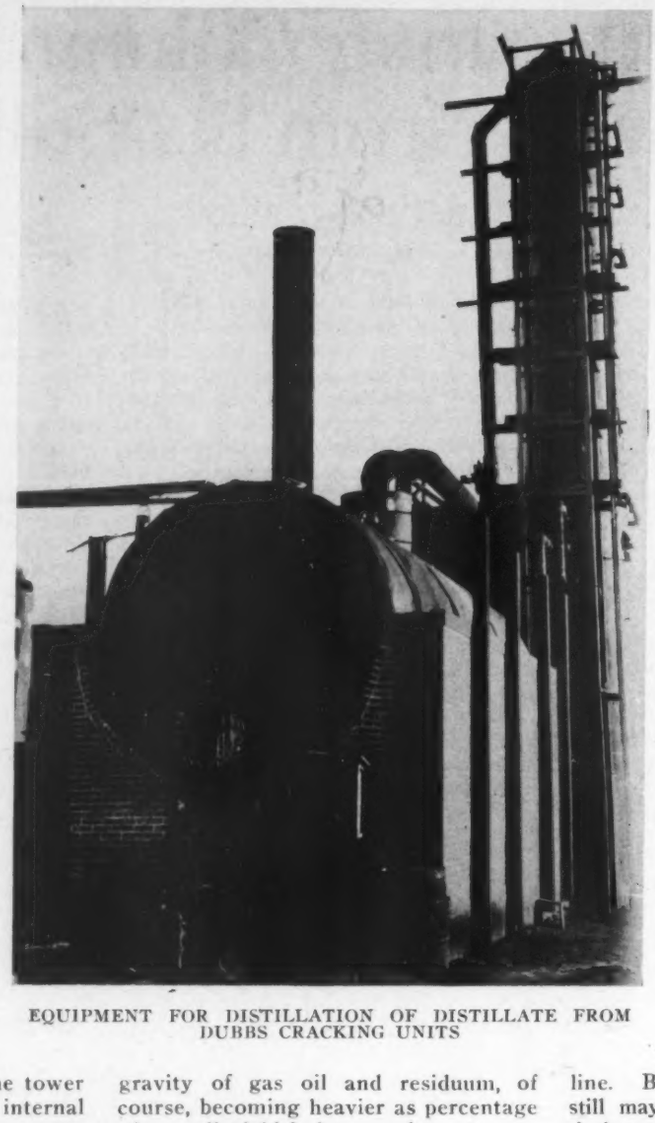
SIX SHELL STILLS HOOKED UP SO THAT FUMES ARE FRACTIONATED IN THE SINGLE TOWER

In this manner the operation of the first five stills in the series yields the two cuts of gas oil and gasoline—both of which products show an improvement in quantity and quality over former methods of operation. It is in line to state here that the fractionating column is equipped with a temperature control section at the top comprised of a closed coil through which a cool gas oil is circulated by pump. This circuit is controlled by an automatic temperature control instrument and a constant temperature is maintained in this "knock out" section of the tower. The tower is six feet in diameter, and the portion provided with bubble cap trays, control section, and tower, is 57 feet 6 inches in height. The

skirt is 1 foot six inches in height, giving an over-all height of 70 feet. It was designed by the Winkler-Koch Engineering Company.

"ReBoiler"

The lower section of the tower, also provided with bubble trays, may well be termed a "reboiler." In this compartment the fuel oil residuum is separated from a further cut of gas oil derived from the sixth still in the series. Crude oil from the bottom or the No. 5 still is jetted into the tower at about its middle, and a little below the bottom separating plate which divides the tower into two sections. This oil upon entering the tower flows downward over a series of bubble plates, leaving the tower at the bottom and returning into the sixth still. Oil in this still is fired at sufficient temperature to vaporize the remaining portion of the gas oil fraction. Vapors leaving this still are conducted to the bottom of the lower section of the tower through a separate vapor line—where they flow upward counter-current to the downward flowing oil jetted into the tower from still No. 5. This scrubbing action assists in stripping the oil of any light portions remaining in it.



EQUIPMENT FOR DISTILLATION OF DISTILLATE FROM DUBBS CRACKING UNITS

Vapors from all stills combine in the lower section of the tower and are conducted through an internal vapor line upward and into the upper section of the column. Thus all of the vapors from the entire volume of crude charged are finally fractionated into the two desired cuts of gas oil and gasoline.

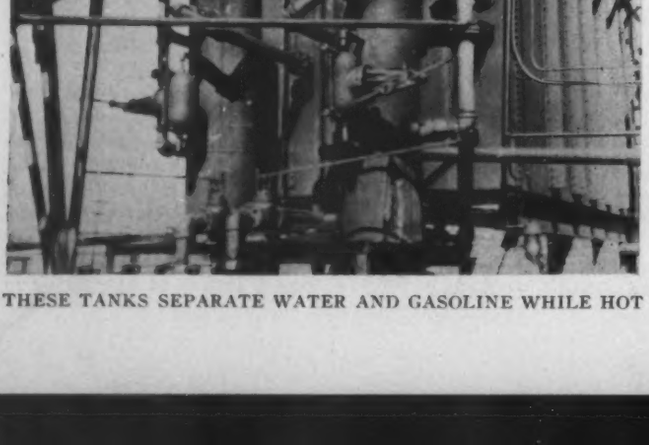
The residuum is drawn off of the bottom of No. 6 still, cooled by exchange with incoming crude and transferred to storage as fuel oil. A feature of this installation is also apparent in the fact that the percentage of gas oil recovered can ve varied at will from none (in which case only gasoline and fuel oil are produced) to 45 or 50 per cent the gravity of gas oil and residuum, of course, becoming heavier as percentage of gas oil yield is increased.

In order to run the large volume of 3500 barrels through the six small stills, six feet by 20 feet in dimension, it was found necessary to enlarge the flow or transfer line from four to six inches, in order that the oil might flow more freely through the series. Additional heat exchanger equipment was also provided when it was decided to increase the plant capacity. This additional equipment delivers the crude to No. 1 still preheated to 300 degrees F. At present the oil going to the stills is passed through two exchangers, then into a "salt and water" separator tank, and then through a third exchanger before reaching the first still. Virtually all of the crude carries with it some salt, water and other impurities—most of which are separated and drawn off in the tank as provided between the heat-exchange units or sections. Experience has shown that the "drier" the crude, the easier it is to handle through the distillation system, and the less is the corrosive action of the vapors derived from such crude.

Valves

Each still is provided with a pop or relief valve for safety purposes. Occasionally stills are taken off for cleaning or inspection, and in this case the relief valve is essential to permit air to enter the still as it cools. These relief valves are not placed close to the still head, or to the vapor line, as is usual practice, but are placed up over the condenser boxes at the end of three-inch lines and quite a few feet away from the top of the still. In this manner a fire-hazard of some importance is virtually eliminated.

Since stills are sometimes taken out of the series for cleaning or repairs, each one in the battery is equipped with a valve between the top of the still and the vapor line. By closing these valves any still may be cleaned or repaired or entirely moved from its setting and replaced by a new still, without interfering with plant operation. At the time of the writer's visit, in fact, one of the stills was being removed and a new still placed in its setting cradle, with the plant still in operation. The company keeps an extra still on hand and in repair at all times, so that in the event of the failure of a still bottom, etc., the operation is not materially hampered. By having a still always ready for insertion in the battery it is but a matter of two or three days' work to install the new still—instead of



THESE TANKS SEPARATE WATER AND GASOLINE WHILE HOT

VAPOR RECOVERY PLANT AT ROOT REFINERY

weeks, perhaps, if such a still were not on hand.

Rerun Unit

Pressure distillate derived from the two Dubbs cracking units is redistilled in a separate unit. Through the control of feed and rate of firing the single still and bubble type fractionating column is operated continuously, instead of batch. The raw "P D." charged to the still is passed through a Ross vapor heat exchanger, counter-current to the hot vapors rising from the still. This pass imparts a temperature of about 200 degrees to the incoming oil. The still is held at a constant temperature of 360 degrees, heated by both fire and steam. Exhaust steam is used mostly in the still keeping the oil in constant agitation. The vapors are fractionated as they pass through the bubble tower, and the reflux condensate is conducted back into the still.

An interesting feature in connection with this operation is that of removing the condensed water from the refined gasoline while both water and oil are still hot. The gasoline vapors leaving the top of the bubble tower, carrying with them the water vapor from the steam used in the still, are condensed in Sterling condenser sections. While both oil and water are still hot they are conducted outside of the condenser box to small vertical closed tanks, which might be termed "water traps." These tanks are provided with Fisher float controllers of the interphase type, which provide for the flow of water away from the traps, and cause the gasoline which accumulates in the upper portion of the traps to be returned to the condenser box where it is further cooled by passing through Sterling cooling sections. The gasoline, free of water, is then conducted into the receiving house. This installation does away with cooling the water from its relatively hot temperature to that cool temperature of the gasoline as it reaches the look box. While it is necessary to condense the water present as a result of the use of free steam in the still, it is not necessary to cool it along with the gasoline, after it is condensed. Separation of the gasoline and water is also somewhat easier to effect when both are hot.

Vapor Recovery Plant

In connection with the operation of the skimming plant and the two Dubbs cracking units, the company has installed a vapor recovery plant of the absorption type, which extracts gasoline from the vapors derived from the storage tanks on the refinery yard, the vapors from the receiving house and the gases from the cracking units. These latter gases are conducted from the cracking plants to the gasoline plant at a pressure of around 30 pounds, at which pressure the recovery plant is operated. Gasoline bearing vapors from the refinery yard proper are collected under a vacuum. This is accomplished by the operation of a Clark Brothers 60 horsepower compressor, size 14—12 by 20 inches. The machine pulls a slight vacuum on the vapor collecting system and boosts these vapors to 30 pounds pressure passing them into the absorption plant system along with the gases from the cracking units. The usual absorption plant method is employed, using an oil produced by the skimming plant as the absorbing medium.

The product, being sour, is treated continuously through a small treating plant, using sodium hypochlorite as the chemical agent. This product is then blended with the plant production and assists in a measure in providing the cracked and straight run gasoline with the necessary lighter or more volatile "ends."

Gasoline derived from Smackover crude oil is relatively high in anti-knock value, and it is claimed for present plant production at the Root refinery, that its cracked gasoline has an anti-knock value of about 40 to 45 per cent benzol equivalent. The product of the Root refineries was among the very first to command a premium over straight run gasoline, because of its anti-knock value. This company was among the first to recognize the true value of cracked gasoline derived from Arkansas crudes, especially Smackover, and among the first to exploit this faculty of higher quality in the general market.

A. I. M. E. Refinery Section Program Arranged

THE scope of the Refinery Engineering Section of the American Institute of Mining and Metallurgical Engineers at New York, February 21, 22 and 23 is outlined in the following from Walter Miller, vice president of the Marland Refining Company and chairman of the program committee:

"For some years these annual refinery engineering meetings of the A. I. M. E. have been in the opinion of many the most valuable national meetings held on the subject. While this meeting at times has encroached somewhat on the field of chemistry which is so ably handled by the American Chemical Society, and while there has also in times past been an apparent duplication of some of the papers presented at the American Petroleum Institute meetings, the subjects chosen for this year have been selected with a view of avoiding any duplication or conflict with the work of other bodies, particularly the American Petroleum Institute meeting held in Chicago in December.

"When the committee was elected for this work last February there was some question as to whether the A. P. I. would definitely take over the refinery engineering meeting work for the industry. The A. I. M. E. Committee, therefore, kept in close touch with the chairman of the Isom Committee and with Assistant Secretary Boyd and Technical Director Anderson of the A. P. I. organization, so it would be able to handle the February program to the best interests of the industry, and without conflict of either subjects or policy. It will be remembered that in the December meeting the A. P. I. directors decided not to take over this work, at least for the time being, and there is therefore no question of divided or conflicting policies.

"The list of contributors of primary papers and formal discussions is ample evidence of the full cooperation of refining companies generally in this meeting, including as it does papers and prepared discussions from members of the organizations of the Standard Oil Company of New Jersey, Sinclair Refining Company, Gulf Refining Company, Tide Water-Associated Oil Company, Standard Oil Company of New York, Atlantic Refining Company, The Texas Company, Mid-Continent Petroleum Corporation, Cities Service Company, and others. In the planning of the program particular attention was paid to selecting those engineering topics which were of immediate and lively interest today. The first session, for illustration, provides a forum for the discussion of the pipe still versus the most efficient conception of the cylindrical type of distilling unit. Both the papers and discussions should bring out into the open many questions which have not been discussed pro and con heretofore in a meeting of this character, and should be very valuable in helping to clear up moot questions which are troubling many engineers in the industry today.

"The third session follows the general thought of the first session in that all the papers are tied into the major subject of the economical application of heat. This provides a vehicle for an open discussion regarding the two principle methods of utilizing the radi-

ant heat principle in refinery combustion, followed by what is believed to be a very complete and scientific exposition of 'The Recirculating Furnace in Theory and Practice.' Incidentally, the opening paper in this session on 'The Role of the Combustion Engineer in Refining,' by Joseph W. Hays will bring out the viewpoint of a man for many years nationally known as a consulting combustion engineer, who has for the past two or three years devoted all his time exclusively to the refining industry.

"The second session while more general in character, will bring out papers and discussions on four different subjects, which are always of direct interest to the refinery engineer and which constitute a continual problem for him. The discussion of 'Sources Automotive Fuels' handled by Mr. Frank A. Howard and Dr. R. T. Haslam of the Standard Oil Development Company will present an authoritative and up-to-date exposition of this subject. Luis DeFlores' successful work on the use of instruments in controlling refining processes is so well known that he is recognized as one of the foremost authorities in this branch of consulting engineering. The next paper on 'The Technological Control of Refining Processes' by Messrs. Miller and Phillips of the Sinclair organization should go far toward picturing the value of technologists in the control and direction of modern refining processes as compared with the old rule-of-thumb method. The next paper in this session may at first glance appear to be a duplication of the A. P. I. meeting, because of the very able paper presented in December by Mr. W. N. Davis of the Standard Oil Company of California, but this is not the case. The A. P. I. paper was devoted to a specific method of handling California sludges, while the paper to be presented by Dr. Rather and the attendant discussions will be a summarization of the knowledge and experience acquired to date on the subject in general, the presentations being naturally more from the point of view of the refiners east of the Rocky Mountains.

"An innovation is promised for the opening paper of the last session. Not all the refinery engineers have the time or the opportunity to learn much about the sources and methods of producing their raw material. There is no one better qualified than Mr. J. M. Lovejoy, who is chairman of the Petroleum Division of the A. I. M. E., to give an interesting talk on this subject, which should give the refining engineers present at the meeting, not a working knowledge, but a clearer and better understanding of the methods used and the problems which have to be met in finding and bringing to the surface the product which constitutes the beginning of their problem.

"Following this there will be a round table discussion on problems in refinery operation. This session will be less formal than the preceding set papers. Three subjects have been definitely set for discussion: First, the question of handling refinery gases, discussion on which will be opened by the nationally known authority, Dr. George M. Burrell. Second, 'The Synthesis of Organic Chemicals by the Refiner,' by Mr. H. W. Camp, Manager of the Cities Service refineries, who by the way has been nominated to be vice chairman of the refining engineering section for the year 1928-1929. Third, the basic principles and underlying theories of contact filtration by Mr. L. L. Davis of the Marland Refining Company. Other subjects for discussion at this round table session will be selected from the most interesting questions which are brought out during the previous there sessions.

"This last afternoon session will be followed in the evening by a banquet. Immediately after the banquet a general meeting will be held of the Petroleum Division, in which will be reviewed the progress in the various branches of the industry during the past year."

PROGRAM

American Institute of Mining and Metallurgical Engineers, Refinery Engineering Section, New York, Feb. 21-23, 1928

February 21—Registration and Committee Meetings.

Tuesday Afternoon—General A. I. M. M. E. Session.

Technical Sessions

I—9:30 A. M., February 22

General Topic — "The Economical Application of Heat."
Chairman—T. G. Delbridge.

1. "The Modern Pipe Still."
   Author—Harold S. Bell, Petroleum Engineer.
   Discussion: H. R. Swanson, Foster-Wheeler Corporation.
   Discussion: P. C. Keith, The M. W. Kellogg Company.
   Discussion: E. P. Kiehl, The Atlantic Refining Company.
2. "The Modernization of the Cylindrical Still."
   Author—C. W. Stratford, Tide-Water-Associated.
   Discussion: W. E. Perdew, Winkler & Koch.
   Discussion: E. H. Dillon, Walter E. Lummus Company.

II—1:30 P. M., February 22

General Topic—"Refinery Problems."
Chairman—C. W. Stratford

3. "Sources of Automotive Fuels."
   Authors—Frank A. Howard and R. T. Haslam—The Standard Oil Development Company.
4. "The Physical Control of Refining Processes."
   Author—Luis de Flores, Consulting Engineer.
   Discussion: W. K. Holmes, The Texas Company.
5. "The Technological Control of Refining Processes."
   Authors: A. E. Miller and E. B. Phillips, Sinclair Refining Company.
   Discussion: Herschel G. Smith, Gulf Refining Company.
6. "The Refinery Acid Sludge Problem."
   Author: J. B. Rather, Standard Oil Company of New York.
   Discussion: L. L. Davis, Marland Refining Company.

III—9:30 A. M., February 23

General Topic—"The Economical Application of Heat."
Chairman: Herschel G. Smith.

7. "The Role of the Combustion Engineer in Refining."
   Author—Joseph W. Hays, Mid-Continent Petroleum Corporation.
8. "The Use of Screened Radiant Heat and its Application to the Petroleum Refining Industry."
   Author—A. E. Nash, Alcorn Combustion Company.
9. "The Use of Open Radiant Heat in Tube Stills."
   Author—John Primrose, Foster-Wheeler Corporation.
   Discussion: E. P. Kiehl, The Atlantic Refining Company.
   Discussion: James S. Alcorn, Alcorn Combustion Company.
   Discussion: W. B. Badger, University of Michigan.
   Discussion: W. Trinks, Carnegie Institute of Technology.
   Discussion: John Primrose, Foster-Wheeler Corporation.
10. "The Recirculating Furance."
    Author: L. A. Mekler, Universal Oil Products Company.
    Discussion: Charles E. Buerger, Gulf Refining Company.
    Discussion: D. G. Brandt, Henry L. Doherty & Company.
    Discussion: E. P. Kiehl, The Atlantic Refining Company.

IV—1:30 P. M., February 23

General Topic—"Petroleum Technology."
Chairman—Walter Miller.

11. "Modern Technique in Petroleum Production."
    Author—J. M. Lovejoy.
12. Round Table—"Problems of The Petroleum Refiner."
    Chairman—Walter Miller.

Burning Acid Sludge as Refinery Fuel

By C. B. FAUGHT, *Superintendent*, and F. R. STALEY, *Chief Chemist*
Texas Pacific Coal and Oil Company

THE disposal of acid sludge, especially in a small refinery not equipped with an acid concentrating plant, or of heavy lubricating sludge in many refineries has ever been a source of expense and trouble. Very often the refinery sludge pond must be enlarged or the banks raised to hold the persistent flow. In some cases where the sludge pond is not used, the acid sludge is run into a pit or large rectangular shallow tank, allowed to cake, and then handled with a pick and shovel. It is usually hand fired to a grate or fed to a stoker along with the pressure still coke or with coal. This procedure involves expensive handling costs, and it is usually difficult to obtain labor to work in acid coke.

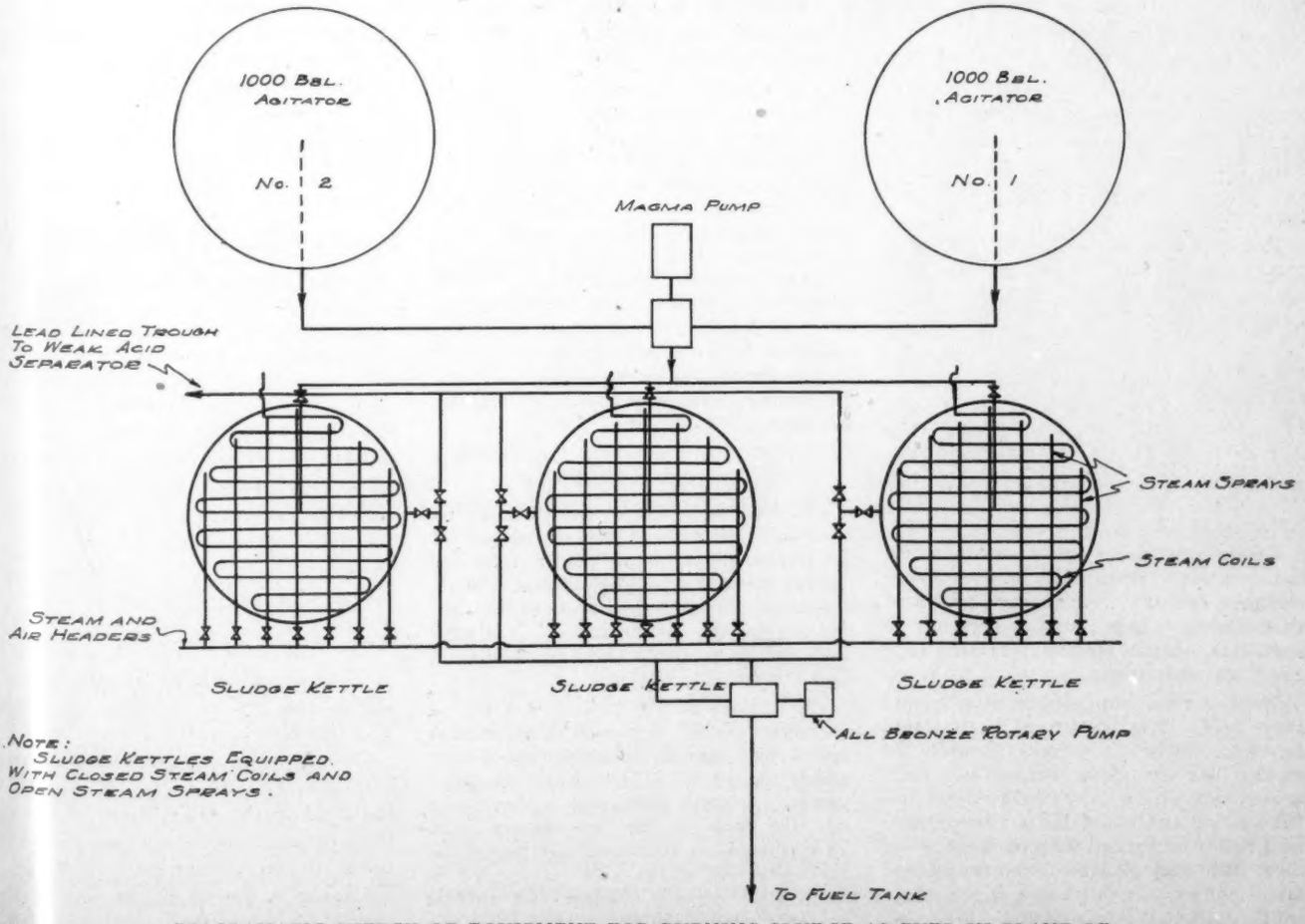
It appears that the best method to handle sludge is to keep it in a liquid state, and to burn it as a fuel oil. If the sludge fuel is properly prepared, and suitable materials are used in the construction of the sludge fuel system, the procedure becomes regular operating routine, and not only requires minimum supervision and maintenance, but the saving in fuel and acid make it a profitable procedure. A fuel oil of high calorific value can be produced that will fire as evenly and easily as any other with the correct type of burner.

Preparation

In the preparation of sludge fuel from heavy lubricating sludges two methods are used. In the first method the acid is separated from the sludge more or less completely, and in the second method the acid is not removed from the sludge before preparing the fuel oil.

The acid separated from the sludge usually contains from 20 to 25 per cent of sulphuric acid. This can be used, as is, in certain refining processes or can be readily concentrated to a heavier product. In this method a definite quantity of water is run into the sludge kettle and agitated with air while a certain amount of sludge is pumped into the kettle through the overhead spray. The batch is then agitated or cooked with an open steam until a homogeneous mass is formed and the water and suldge are thoroughly mixed and brought up in temperature. After the proper cooking the batch is allowed to separate for a number of hours and the weak acid settles to the bottom of the kettle. The acid is drawn into the separator, and then pumped to the settling tanks. The sludge remaining in the kettle is then mixed with fuel oil. This fuel oil is pumped into the kettle and the batch is agitated with air until thoroughly mixed, which also dries out the batch, since it is at about 150 degree F. The fuel oil used can be of almost any gravity or viscosity since gas oil, pressure still fuel, and reduced asphalt base crudes have been used successfully. In the mixing, about equal parts of sludge and fuel oil are used.

If the proper materials are used in the



DIAGRAMATIC SKETCH OF EQUIPMENT FOR BURNING SLUDGE AS FUEL IN PLANT OF TEXAS COAL & OIL COMPANY, FORT WORTH.

handling equipment it is not necessary that the fuel be thoroughly dry or entirely free from acid. After the fuel has been vaporized and burned the products of combustion have no corrosive effect on the boiler tubes or still settings.

In the second method of preparing the sludge fuel, where the acid is not removed, there seems to be a difference of opinion whether or not the acidity should be neutralized. In the first place it would require tons of lime or soda to entirely neutralize the acid in the average batch of sludge, and therefore where these chemicals are used only partial neturalization is obtained. The sulphates formed are deposited in the fire boxes where they form an insulating scale on the boiler tubes or, especially in the case of soda, rapidly decompose the fire brick. In view of these facts, and since the products of combustion of an acid containing fuel have no apparent effect on the tubes and boiler settings at high temperature it has been found better practice to blend the sludge in the kettles with fuel oil without neutralizing it. In this method no water or open steam is used, but the selection of the proper fuel oil is necessary. It has been found that a fuel oil of high viscosity must be used to prevent the separation of the sludge from the mixture. A reduced asphalt base crude having a viscosity of at least 150 seconds Furol, at 122 F. has given the best results.

Equipment

In the sketch is shown the complete layout of the agitators and the sludge separating and mixing equipment.

The lubricating stock is pumped into No. 1 agitator and is maintained at a predetermined temperature until the acid is added. These agitators are insulated and have umbrella type roofs. No moisture can get into the oil at any step of the treating.

The acid is added and breaks out in a practically oil free sludge which settles rapidly and is pumped with a Magma pump through six-inch lines into one of the three sludge separating kettles. On the end of the discharge line over the center of each kettle is a short length of pipe in which a great number of one-quarter-inch holes have been drilled. The end is plugged and also drilled. The pump is used to force the sludge through these holes. This breaks the sludge into small streams, making it spread out over a greater area in the mixing kettle, which has previously been filled with a predetermined amount of hot water. Two of these kettles have ample capacity to handle one batch, leaving the third as a spare on each treat.

These kettles are lined with 10-pound sheet lead. The bottom of each slopes on an angle of 30 degrees towards the suction line and draw off valves. Each is equipped with a closed brass steam coil for heating and maintaining a predetermined temperature, and with open sprays of three-inch lead pipe for open steam and air.

Up to the time the sludge enters the kettles, little or no attention is given to non-corrosive metals for handling this material.

One Metal Used

After the sludge is dropped into the water, trouble begins. Careful laboratory research on metals and their behavior in the presence of each other in weak acid shows that the electrolytic action of dissimilar metals in presence of weak acid was more detrimental that the action of the acid itself, due to galvanic action. Metals which showed the least action were selected. Cast iron and steel lines were used and found very unsatisfactory. Brass lines and fittings were then installed, with pumps of all bronze liquid ends. This combination has proven very effective where the installation is entirely of the one metal. Deterioration is very rapid where brass and cast iron or steel are used together, due to galvanic action which sets up at once.

The sloping bottom of the kettles allows all the recovered acid to be drawn off and also all the fuel after mixing. This gives a clean kettle for the next separation. The acid water is drawn down through lead lined troughs to a three compartment lead lined trap similar to an oil trap. The acid is then pumped to storage from the last compartment. Any sludge drawn down with the acid is left in the first and second compartments.

After the fuel has been prepared, it is pumped to the suldge fuel tank near the boiler house.

Again all brass lines, fittings and valves are used. A five valve manifold of flanged end tees and valves gives easy access to each kettle. An all bronze, rotary type pump is used in handling the sludge fuel. Suction is taken on the draw off valve on the low side of the kettle and the finished sludge fuel is pumped directly to the boiler house feed tank. At this plant, the balance between fuel requirements and sludge fuel produced is so even that all the sludge fuel is burned in about 20 hours. None is stored, which eliminates many problems usually arising when sludge fuel is stored. One of the essential features of successfully handling sludge fuel is to burn it as it is made. No graining out or settling will then be encountered.

Avoid Moisture

The feed tank is also lead lined and is equipped with a three-inch closed coil on the bottom of the tank. Open steam for heating is to be avoided as open steam hydrolizes the sulphuric acid causing undue corrosion. Water in fuel is always bad, due to necessity of using additional fuel for its evaporation.

The bottom of the tank is cut off on an angle of 30 degrees. Two suction valves feed two all bronze rotary pumps which are set up independently as relief pumps. A small open pipe is run down into the tank to the two suction lines. This permits an occasional stirring of the fuel with air which aids in keeping it thoroughly mixed. When the fuel is properly compounded, this tank will not need cleaning for long periods.

Inside the pump room, the entire system is all brass, as are the feeder and return lines to and from the burners. The fuel is maintained at about 150 F. and an excess is pumped through the burner line so as to keep it moving all the time. These lines are insulated where exposed to the elements. This prevents undue cooling of the returned sludge and saves the expense of heating again.

All of the fittings inside the boiler house, including the burners, are of brass. The burners are of the spray type with large opening in the tips to allow thorough atomization. No trouble is experienced in burning the sludge which has a heat value of about 19.000 B.T.U.'s per pound. In fact, the firemen have become so efficient in its use that they prefer it to ordinary fuel oil.

Every precaution has been taken in the entire procedure to minimize the labor required to mix and burn the fuel. The usual dangers attendant upon handling sludges have been eliminated. All of the sludge is being used without further handling, and the general appearance of the plant is greatly improved and maintained.

Other metals than bronze and brass may be used in sludge equipment. However these have given satisfactory service where many different kinds have fallen down. It is essential that dissimilar metals are not placed together in the system as rapid deterioration and excessive repairs will occur.

The methods and equipment outlined are in successful operation at this refinery based on nearly two years of research and operating experience. All of the sludge produced is being consumed as fuel oil, which has been found to be the most economical and efficient method of disposal.

Louisville Refinery to Resume Operation

Louisville—The plant of the Louisville Petroleum Refining Company here will soon be in operation again, following renovation by J. Fred Miles of Lexington, who purchased the property several months ago. The refinery was built several years ago by Colonel E. H. Hilpp and associates, but has been shut down for some time. The new owner has been operating in Kentucky for 12 years, and previously was active in Oklahoma.

The Louisville refinery has a capacity of 3500 barrels daily. It consists of a double unit Dubbs cracking plant, with Winkler Koch fractionating towers.

Oil will be brought to the plant from the Ohio County field, coming out of the field to the Ohio River at Owensboro through a new pipe line, and from there to the refinery by steel barge.

Charles A. Jouett will be superintendent of the new plant, and H. R. Smith will have charge of traffic and sales.

Steam Leaks and How to Stop Them

FEW oil refineries are operating that pay as much attention to the repairing of steam leaks as well as might be paid. When an inspection is made of the average refinery, steam leaks are repeatedly seen, being more especially noticeable in winter than in summer. Attention is usually given by the management to very bad leaks, but small ones are often overlooked because of the opinion their loss is nominal. This is not true, for even small leaks represent substantial loss in money, and then, too, it must be remembered that most steam leaks become greater if not given prompt attention. Procrastination in the matter of repairing steam leaks is too common a condition in oil refineries, a state of affairs that should not exist if efficiency in operation and lowest possible refining costs are to be attained.

Steam is such a commonly used medium in oil refineries that many plant engineers and superintendents who are concerned with many other important matters, dislike to appear trivial by having the maintenance gang "chase-up" the small leaks and stop them. However, a little calculation will show that such losses are of no small account, same being realized all the more when the losses are translated into those terms used in connection with other refining operations, namely, dollars and cents costs.

Cost of Small Leaks

For example, although the amount of steam in pounds lost per hour from small leaks in a system operating at 100 pounds pressure is only as follows:

1/32-inch	4.4 lb.
1/16-inch	17.7 lb.
1/8 -inch	70.1 lb.

Still, when those same losses are applied to the cost of steam in a year's period of time, the figures in dollars become:

1/32-inch	$ 20.63
1/16-inch	82.60
1/8 -inch	327.40

Table I* gives further data on the amount of steam lost at pressures of 150, 200, 250 and 300 pounds per square inch when the diameters of the orifice through which the steam is leaking are 1/16, 1/8, 1/4 and 3/8 inches. This table also shows the amount of steam in pounds discharged from leaks of such size in an hour; the pounds of coal wasted; and the cost of the leak per day, per month and per year, calculated on the use of coal at $4 per long ton. This estimate can be corrected to the basis of fuel oil, at whatever its value per barrel may be, merely by making the calculations on equivalent B. t. u. values of coal and fuel oil.

Data given in Table I and in a preceding paragraph should serve as an incentive for every refiner so to educate his men that a steam leak receives immediate attention.

TABLE I

Costs of Steam Leaks Through Openings of Various Sizes

Gauge Pressure in Pipe Pounds per sq. in.	Diameter of Orifice in inches	Discharge Pounds of Steam per hour	Pounds of Coal Wasted per hour	Cost of Leak Using Coal at $4.00 per Long Ton. per day	per month	per year
150	1/16	25.9	2.90	$0.124	$ 3.73	$ 44.75
150	1/8	103.8	11.50	0.493	14.77	177.20
150	1/4	415.0	46.10	1.973	59.20	710.00
150	3/8	935.0	103.80	4.440	133.30	1,600.00
200	1/16	33.6	3.75	0.160	4.82	57 80
200	1/8	134.8	15.00	0.643	19.27	231.20
200	1/4	539.0	60.00	2.566	77.20	927.44
200	3/8	1,214.0	134.80	5.780	173.50	2,085.00
250	1/16	41.4	4.60	0.197	5.92	71.10
250	1/8	165.7	18.40	0.788	23.65	283.50
250	1/4	73.60	3.145	3.145	94.30	1,133.00
250	3/8	1,492.0	165.70	7.090	213.00	2,555.00
300	1/16	48.8	5.44	0.233	6.99	83.90
300	1/8	195.2	21.70	0.928	27.84	334.50
300	1/4	781.0	86.80	3.710	111.30	1,334.00
300	3/8	1,757.0	195.20	8.365	250.95	3,010.00

Stopping Steam Leaks

The stoppage of steam leaks is usually not an easy matter, in view of the fact that such leaks may occur in joints already drawn up tight. It is not always possible to shut off the steam and close the holes, more especially so in oil refineries where most of the system must be operated 24 hours a day. In most cases the leaks are too stubborn to be closed by ordinary means.

Recently, however, a new compound has been developed to cure the trouble without a shut down. To apply this compound and make a permanent and absolutely tight job, auxiliary equipment was found necessary and this also has been designed and is now available. The compound is known as Furmanite, being a material that is solid at ordinary temperatures. When first heated it softens to the consistency of a heavy oil. Under the continued action of heat it hardens into a tough, semi-resilient material, very similar to a good gasket. In this state it is said to last indefinitely, adhering to metal or to gaskets in joints and effectively blocking the passage of all ordinary fluids, such as steam, air, water, etc.

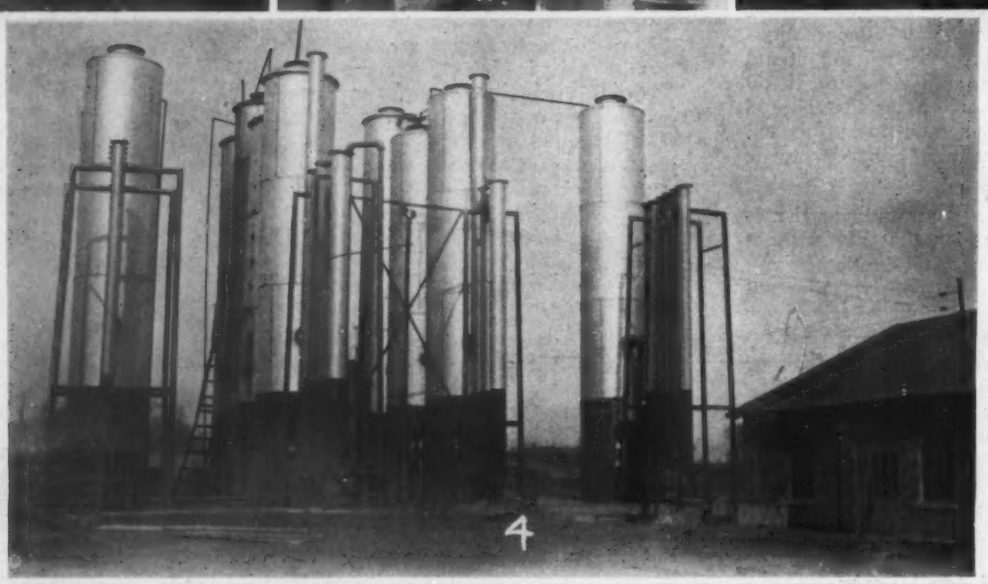
When used to seal joints or leaks in lines that are in service, this material must be applied under a pressure higher than that of the line. For this purpose a pressure gun is supplied. To dam up the joint while the compound is soft, other small appliances are also employed. The heat in a steam line is sufficient to harden the compound. If used on an air or cold water line, a torch can be applied to the outside of the metal to bake the compound in place.

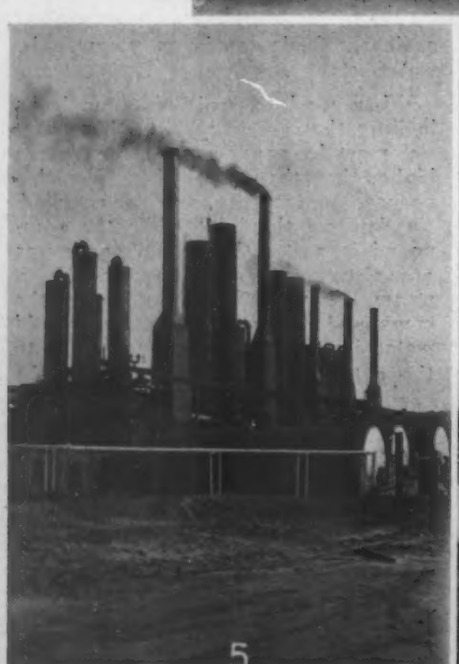
In sealing a leak in an ordinary flange joint a strip of sheet lead is held securely around the flange by a cable and tightening device to prevent the compound from running out. The nut nearest the leak is removed and replaced by a Furmanite nozzle to which the pressure gun is screwed. The compound is shot into every crevice by this gun and in 10 minutes has permanently hardened. The equipment is then removed and the original

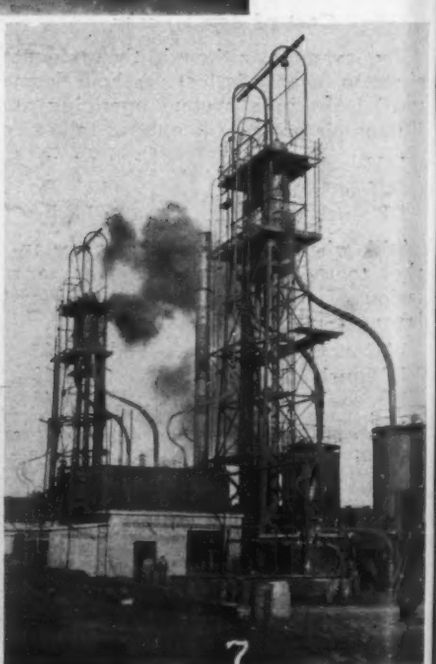
(Continued on page 104)

*From an article, "Stopping the Steam Leaks," by E. F. Heard, in Manufacturing Industries for June, 1927.

Views of Johnson Oil Refining Plant, Cleveland, Oklahoma







1—All metal loading rack. 2—Mechanical arrangement of swing loading rise where stop-cocks replace valves. 3—Water-top tanks for gasoline storage. 4—Continuous treating system to acid treat pressure distillate and to doctor treat gasoline. 5—Installation of bubble towers. 6—Gasoline recovery plant to handle vapors. 7—Battery of Dubbs cracking units.

2 YEARS

The first Smithsteel Cracking Still

WITHOUT LEAK SEEP *or* SWEAT

That is now the record of the first Smithsteel Stills made by the exclusive and patented Smithwelding Method.

Two years without Leak, Seep or Sweat. Invariably 100% joint efficiency.

A. O. SMITH CORPORATION, *Oil and Gas Field Products Division*
General Offices—Milwaukee, Wis. *District Offices at* Pittsburgh, Tulsa, Dallas, Los Angeles

SMITHSTEEL CRACKING STILLS

Mention Where You Saw the Advertisement

Fractionating Equipment Increases Plant Yield

By GEORGE REID

INSTALLATION of bubble type fractionating equipment at the Cleveland, Oklahoma, plant of the Johnson Oil Refining Company, in addition to improving both quality and percentage of gasoline recovered from the crude, also made possible an increase in capacity from around 3000 barrels daily to the present capacity of 5500 barrels. During the last year and a half since their installation, bubble towers have continued to fractionate close cuts of gasoline without shut down for repairs. This installation, as well as numerous others, has done much to dispel the fears of some plant operators who felt at the inception of bubble type tower development that troubles would arise with the bubble tray mechanical arrangement, due to its apparent complexity as compared with the old fashioned baffle tower design.

The Johnson plant was among the earliest to be equipped with bubble tray towers in conjunction with a series of shell stills in continuous operation. Similar to the number of subsequent installations elsewhere these towers were inserted in the battery of continuous stills at strategic points where maximum fractionation was desired. At this skimming plant, which consists of 10 shell stills, six of the horizontal stills are employed in the distillation of crude oil, and the remaining four stills are used in the redistillation of Dubbs cracking unit pressure distillate.

Since close fractionation was not essential for separation of the vapors leaving the first and second stills in the crude oil series, the bubble towers were installed on the third and fourth stills. The tower on the third still is 38 feet in height and six feet in diameter and contains 16 bubble plates. All of the towers are provided with inspection plates at each tray, which practice has been recognized as almost essential in design of such columns.

Because closer fractionation is desired from the fourth, or last, gasoline still, a larger bubble tower was installed, 42 feet in height, or the same diameter as the first tower, but containing additional bubble trays.

The crude flow through the plant is similar to that of other plants designed to operate in the same manner. Crude oil enters the first still through the heat exchanger and sufficient heat is applied to vaporize a portion of the lighter gasoline vapors. These are conducted to Sterling condenser sections and to run down. Crude bottoms flow by gravity into the second still, where a slightly heavier cut is removed and handled in the same manner. These two stills are equipped with double baffle towers.

Control of Flow

A novel idea in connection with towers and condenser boxes is incorporated in this plant. The stills are erected in units of two stills per setting. Likewise the condenser boxes and tower equipment is in units of two. Behind the towers where the 12-inch vapor lines conduct the vapors from the top of the towers to the condenser boxes, these large vapor lines are equipped with 12-inch rising stem gate valves and manifolded together in such a manner that the vapor flow from either tower may be diverted from its route to flow into either of the two condenser coils. For example, when leaks occur in one of the two condenser coils, the flow of vapors from the still affected may be instantly diverted into the other box or condenser coils. This makes it possible to continue the operation of the still affected without shutting it down while repairs were being made to the coils. The cost of such large valves and additional footage of 12-inch vapor line required to install this manifold is more than offset by the elimination of time lost by stills when leaks occur in condenser coils. Naturally, when vapors from two stills are run through a single coil, the water box affected is temporarily over-worked, but since such conditions rarely extend over a period of one day, no great harm results. Because of this type of vapor line manifolding the plant has never lost time or capacity due to leaks occurring in condenser coils. Since coils will scale and corrode and require periodic repairs, the scheme of manifolding the vapor lines is certainly commendable. It is simplified in operation at the Johnson plant, since the first four stills are all engaged in the production of gasoline which is taken to rundown to a common tank. The same type of operation prevails with the rerun stills working on pressure distillate.

From the bottom of the second still the crude is picked up by a Gardner hot oil pump and charged into one of three inlet lines entering the first bubble tower. As the crude descends to the bottom of the tower and over the bubble trays, it scrubs the rising vapors coming from the third still. The oil and reflux material is conducted into the third shell still through the reflux line. A slightly heavier fraction of gasoline is taken overhead from the bubble tower.

The oil accumulating in the third still is pumped by a second hot oil pump into the second bubble tower, to flow downward and into the fourth still through the reflux line. The final stream of gasoline is take off of this tower. Production of kerosene is optional with the company, and its percentage is varied to suit market conditions. Much of the time kerosene is not produced. The last two stills in the series are used in the production of gas oil or distillates, as required. When gas oil is not produced one still is auxiliary. Crude oil in this battery is topped to a residuum of about 26 degrees Baume—which is used for charging stock for the four Dubbs cracking units. Operation of the redistillation equipment, in the handling of pressure distillate is similar to operation of the crude still battery in so far as process methods are concerned. Still bottoms off the re-run battery are not returned to the cracking coils, but are blended with the straight run cut of stove distillate and marketed as such. There is a brisk demand for this commodity during the cooler months.

Handling and Treating Gasoline

Gasoline produced by both the skimming plant and the re-run battery operation is conducted to common rundown tankage. This practice is somewhat different from the methods of many refiners who handle their straight run and cracked gasolines separately throughout the entire system. At the Johnson refinery the pressure distillate is treated with sulphuric acid and neutralized with caustic in a continuous treating system. The treated pressure distillate is then redistilled and the cracked gasoline conducted through condenser sections to the same rundown tanks in which the straight run gasoline is also stored.

Gasoline derived from the operation of the vapor recovery system, which amounts to an average production of 1500 gallons and is derived from uncondensible vapors from the four Dubbs cracking units, the run-down tank vapors and the receiving house gases, is also conducted from the tankage at the absorption type recovery plant to the refinery run-down storage. Blending this light gasoline in with the straight run and cracked gasoline eliminate all losses due to evaporation, since none of this gasoline is handled through open storage tanks.

The entire production of gasoline

from all scurces is handled through vapor tight tanks. These tanks are all water-top, and equipped with Davis regulator vacuum-pressure relief valves. With such equipment all gasoline produced is kept continuously in closed equipment.

Leaving the working storage the blend of gasoline from all three sources is taken to the continuous treating system, where it is chemically treated with sodium plumbite solution. Such practice has proven successful to a satisfactory extent and the production of gasoline consisting of straight run, cracked, and absorption plant product is treated at one time to satisfactory color standard. Cracked gasoline is not treated separately by acid, caustic or doctor, etc., in an effort to secure color stability, but is blended in proper porportion for chemical treatment, securing color stability, and effected a material reduction in treating costs, and cost of transferring and additional storage facilities. Color requirements in regard to cracked gasoline are secured by proper pretreatment in continuous system and precision methods in the subsequent distillation of the treated distillate.

Stops Replace Wheel Valves

One of the features of interest at the Johnson plant is the use of the familiar stop-cock instead of the customary wheel valve where smaller valves are required. Many places about the refinery where lines of two and three-inch sizes are employed, the wheel manipulated valve has been replaced by the stop-cock. The type of stop is governed to some extent by the work to be done and the frequency of opening and closing. Where such valves are used a great deal, are opened and closed many times each day, the lubricated type of stop is employed. Other lines which are less frequently used, the ordinary stop is employed.

The loading rack has a peculiar appearance due to the lack of valve wheels on the rising loading lines. The rack, which is located near the main pump house, is built of structural steel and platformed with rough corrugated steel plate for safety, and provided with sturdy guard rails. Each loading riser is equipped with a lubricated stop-cock, whether the line is used for loading gasoline, kerosene, stove distillate, gas oil or fuel oil. These cocks have given little or no trouble so far as leaking is concerned. Occasionally one of them will leak a few drops, which indicates the need of a charge of the lubricant or repacking the gland. The most important feature regarding their use has been the entire elimination of broken and bent valve stems and the accompanying loss due to leakage, and the elimination of delay due to lost valve wheels. The loaders are provided with a number of welded handles made to fit the stop-cocks on the rack, which they carry about the rack with them for opening and closing the stop-cock type of valve. All lines at the rack are of the same size, therefore all the stops used are of standard size. Merco-Nordstrum lubricated stops are used on the loading lines.

Cracking Units

The battery of four Dubbs cracking units, is located at some distance from the skimming plant, and with its conjunctive equipment, such as power house, etc., is a complete plant in itself. Each of the four units was equipped with Dow surge pumps, for circulation of the hot reflux from the dephlegmator leg, over one and a half years ago. At the time of their installation the pumps effected an increase in capacity of 35 per cent for the battery of stills and from 6 to 8 per cent increase in gasoline in the pressure distillate. In the matter of repairs and upkeep the hot oil pumps have been in almost continuous operation, and all four duplex, double acting pumps have only required three new rods in the total time of service.

Residuum from the Dubbs units is conducted under operating pressure from the expansion drums of each unit to a series of three large flash tanks. The residuum is sprayed into these tanks near to top to fall downward over baffles. The temperature in the flash tanks is around 550 degrees, which is sufficient for the vaporization of whatever light products are held in the heavier oil by absorption, etc. The lighter vapors liberated are conducted by small vapor lines to condenser coils and cooled. As the coke accumulates in the bottom of the flash tanks it becomes necessary to remove the residuum from either of three lines at the side of the tanks, which gives three oil levels in the tanks. This residuum is handled while hot by a large hot oil pump which keeps in constant circulation from the tanks to burners. By-pass lines are so arranged that the oil is kept moving, for the reason that it solidifies, more or less, on standing still or cooling. Sufficient residuum is made by the units to fire all of the units and the six boilers in the nearby power house. The company does not market any residuum as fuel oil, but markets its better grades of coke about as fast as it is manufactured. At the time of the writer's visit the cracking units were operated for the production of sufficient residuum for plant operations, coke, and pressure distillate which ranged from 70 to 72 per cent in gasoline content.

The Johnson Oil Refining Company has installed its own generating plant for power and lighting purposes. The plant consists of a Ridgway Steam Engine, 225 horsepower, driving a 440-volt, three-phase, 60-cycle, Ridgway alternator. The generator is also Ridgway, 125-volt, 80-ampere. This installation generates ample electricity for lighting the entire plant yards, both the skimming and cracking plant; several electrically driven pumps at the plant, and four motor-driven centrifugal water pumps at the company's water station two miles away.

Shallow water wells at the river side, two miles from the plant, furnish around 2,000,000 gallons of water daily for plant use.

California Company Will Build El Paso Refinery

El Paso, Texas.—A refinery site has been purchased two miles east of El Paso by Standard Oil Company of California to erect a 10,000 barrel daily capacity plant, which is scheduled to be completed and put in operation on West Texas crudes before the close of 1928. The Pasotex Petroleum Company has been organized by the above Standard unit to build and operate the plant, and the bulk of the refined products will be marketed through the parent company's sales unit in the lower Rocky Mountain region and northern Mexico.

Standard Oil Company of California is developing producing properties in Mitchell and Pecos Counties through its subsidiary, The California Company, and has held controlling interest in the second largest refinery in West Texas for several years. This plant is operated under the name of Col-Tex Refining Company at Colorado, and has a daily capacity of 7500 barrels. Standard owns 62½ per cent of the stock, and Anderson-Prichard Oil Corporation, Oklahoma City, owns the remainder. This plant is operating, and consuming most of the crude produced in Mitchell and Howard Counties. The products manufactured by this plant are sold by the minority stockholders.

In connection with the El Paso refinery project, a direct pipe line connection with prolific properties held by The California Company in the Yates shallow field is also proposed. This line would require about 275 miles of pipe. The nearest crude available for the El Paso plant would be the Hendrick field, but transportation would be limited to tank cars.

Either eight or 10-inch pipe will be used in connecting the refinery at El Paso with the Yates field, and present plans call for three main line stations, equipped with a pair of 12,500-barrel daily capacity each pumping units, but only one unit will be used, with the other held in reserve, or until the capacity of the refinery is increased.

Gravity will be in favor of the oil movement into El Paso after crossing the mountain range in Hudspeth County.

Houston.—Humble Oil & Refining Company is erecting a new $75,000 office building at its plant at Baytown. It will contain 15 offices and will house the time and accounting offices and the cashier's department.

Burning Oils—Their Characteristics and Manufacture

By GEORGE W. CULPIT, JR.
Chemical and Refining Engineer

LONG before a commercial use for gasoline was developed, kerosenes (long-time burning oils) played the most important part in light oil refining. It was not uncommon to discard the light napthas and gasoline cuts which first came over in the distillation of crude oil in order that that cut might be obtained which could be used to light and heat the homes of our early ancestors. Today, we use this class of oils for more purposes than lighting and heating, consequently, the specifications of these oils are more stringent.

As time has gone on, not only have the physical properties been ascertained, but likewise the chemical properties. Through the understanding of the latter, many bad features have been eliminated, making it possible to turn out a good product from what may be termed an inferior stock. In general, apparently, this seems to be the task of every petroleum refiner. That is why, no doubt, the name refiner has been so universally applied.

There are many kerosene oils now on the market, such as Rayolite, Standard White, Petrolite, 300 Mineral Seal, Kerolite, etc., and each requires a specific process of refining, depending on the nature of the crude oil from which it is to be refined. The following tests represent those which every burning oil in general must meet: Gravity, viscosity, sulphur content, flash, color, over at 410 degrees F., burning time and consumption of oil while burning. While we are discussing tests which these oils must meet, it may lend more light on the subject to outline certain specifications these oils must meet before they may be considered as finished products.

The methods for testing kerosene oils are given in the new and revised Tag Manual for Inspectors of Petroleum; therefore, for such tests I refer you to that book. There is one test to which I wish to refer you, and that is the lamp test. As a final test for these oils, the real quality of the oils is determined by subjecting them to a burning test and noting the results which they give as far as lamp conditions are concerned. There are standard lamps for this work, among which are the following:

Saybolt test lamp—No. 2 Sun hinge.

Saybolt brass lamp—Tagliabue Co. burner.

Nickle lamp—Plumb & Atwood Co., Conn., U. S. A.

McGowan test lamp—No. 1 Sun hinge burner.

In order to give consistent and reliable results, the chimneys for these lamps are likewise standardized and are manufactured by the MacBeth-Evans Glass Company in Pittsburgh, Pa. Another important feature regarding the lamps is the wick. Too much stress cannot be laid upon the importance of the correct interpretation of the wick test. In many instances a burning oil has been rejected due to the fact that a tester has misinterpreted the condition of the wick, due to lack of observation or the want of experience. The crustation on the wick should be carefully noted as to whether the deposit is light, medium or heavy; soft or hard; loose or caked. It should be noted as to whether the fibre of the wick has been weakened, and what the nature of the toadstool (if any) is after burning. The flame of the lamp should be noted with regard to uneven burning (raggedness), drop in height of the flame during burning, and the tendency of the flame to become distorted.

Certain methods for lamp testing require varying quantities of oil for a charge, and while one standard lamp requires 600 c.c. of oil as a charge and burns to dryness, another requires 850 c.c., replenishing the lamp with 400 c.c. every eight hours. Each standard lamp has a specified method for determining the burning test of an oil. In determining all lamp tests, it should be remembered that when the wick has once been lighted the lamp should be placed in a hood where no outside currents of air can come in contact with the flame.

Chemical Characteristics of Burning Oils

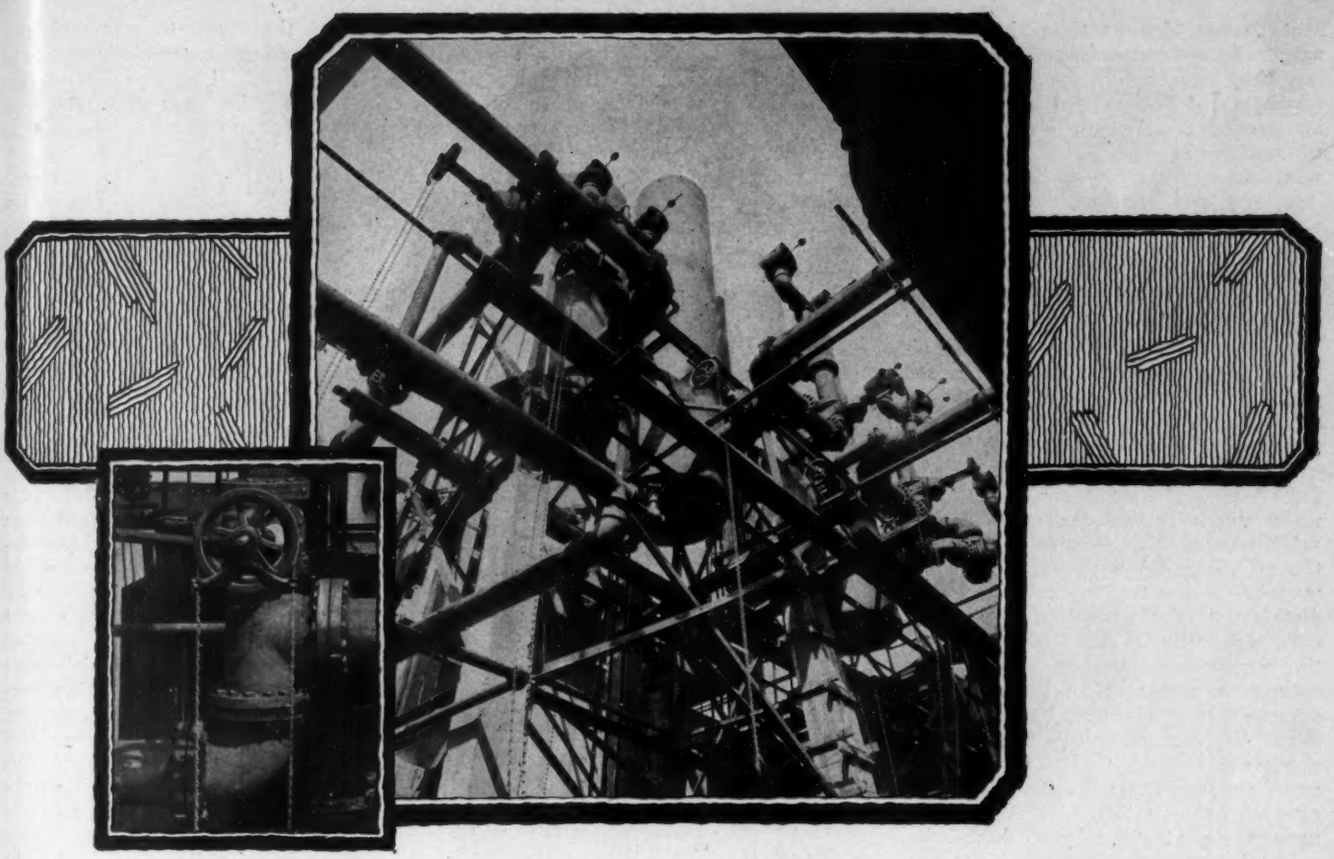
Besides possessing the above physical characteristics, there are several others which I wish to mention before taking up the preparation of the burning oil distillates themselves.

Burning oil distillates ranging from 39 to 44 degrees Be. gravity possess the property of being easily chlorinated, and this method was at one time used in the refining of same. Sulphonation later replaced chlorination of the distillates for various reasons. First, on chlorination, hydrochloric acid (HCL) was formed, which was very undesirable; second, the oil became very hot, and third, the viscosity became high, with the result that the specific gravity at 60 degrees F. became 1.243. Upon neutralizing the chlorinated oil with alcoholic potassium hydroxide (KOH) under a reflux, no apparent action was noticed save for the odor of cloves detected upon opening the flask.

Sulphuric acid, 93.5 per cent acidity, changed the color of the chlorinated oil to purple, with the liberation of a great deal of hydrochloric acid. It was noticed from time to time that added quantities of hydrochloric acid were formed even when the product was agitated with calcium carbonate and filtered. Standing over night produced a strong acid reaction. The stability of the chlorinated lamp oil was determined by immersing strips of various metals in it and allowing to stand for different periods of time. At the end of 15 hours, the specific gravity of the oil increased from .802 to 1.243. The gain in weight was approximately 70 per cent, and the gain in volume was approximately 10 per

	Rayolite	Petrolite (Foreign)	Petrolite (Domestic)
Gravity	42.0-42.5°	41.0-41.5°	40.0-42.0°
Viscosity	415-430	430-450 max.	385-400
S. D.	.06-.075%	.10%	.09%
Flash (Abel)	140-145	135-140	135
Color	+18-+21 (Saybolt)	+12 (Saybolt)	+12 (Saybolt)
Over at 410°F.	15.-20.%	15.0-20.0%	20.0-25.0%
Burning Time	18 hours	18 hours	40 hours
Consumption	—	—	50 c. c. per hour

	300 Mineral Seal	Kerolite	Standard White
Gravity	39.0-40.0°	41.0-43.0°	43.0-43.5°
Viscosity	39.-44. at 100°F.	400-410 at 60°F.	330-335
S. D.	-	.09-10%	.07%
Flash (Abel)	-	135° F.	125°F.
Color	+16 (Saybolt)	+16 (Saybolt)	+14 (Saybolt)
Over at 410°F.	-	-	35.-40.%
Burning Time	-	18 hours	56 hours
Fire	300	-	-
Floch	None	-	-
Cloud	30. max.	None	None
Consumption	-	45. c . c. per hour	52 c. c. per hour.



Refineries Require Gate Valves Which Open and Close Easily

The gate valve in the oil refinery is often inaccessibly located. It becomes essential that the valves be easy to open, easy to close and close tight. They must be free from liability to disassemble internally or stick when being operated. They must be easy to repair when repairs become necessary.

Darling appreciated the work refinery and oil field valves had to perform before the Darling Gate Valve was offered to the industry. They have proven their worth not only as the tightest seating valves, but are equally as noted for their ease of operation, long wear and freedom from repairs. In the Darling Gate Valve all working parts are plain and devoid of pockets where scale and sediment might collect to interfere with tight closing or full opening.

If gate valves have been a problem, try a Darling and keep a check on its performance.

DARLING VALVE & MFG. COMPANY

Williamsport, Pa.

New York Chicago Oklahoma City Houston

Mid-Continent Distributors

Frick-Reid Supply Company — Atlas Supply Company
International Supply Company — Petroleum Supply Company

California Distributor
Petroleum Equipment Company, Los Angeles

DARLING
GATE VALVES

Mention Where You Saw the Advertisement

cent. It was obvious, then, that chlorinated oils were unstable. Upon standing, they slowly decomposed with the formation of hydrochloric acid. Metals were attacked when in contact with the chlorinated lamp oil. Aluminum was attacked least, followed by copper, iron, zinc and tin.

Another point which helped to eliminate chlorination of lamp oils was, that upon redistillation of the chlorinated product such violence was caused, (by liberation of hydrochloric acid gas), that the still nearly blew up although the temperature was raised gradually. On this account, the use of sulphuric acid for the removal of unsaturated and other undesirable hydrocarbons was adopted. Many interesting facts were obtained, among which the more important are as follows. On sulphonation, the specific gravity of the oil decreases with increase in the severity of the treatment. The actual distillation of the oil remains practically unchanged. This indicates that the removed components have a higher specific gravity than the remaining components at identical boiling points. Also, the removed hydrocarbons are composed of such that they add halogens, and such that combine with halogens by substitution. The former are more easily attacked by 66 degree Be. acid than the latter, which require fuming acid for their removal. Now that numerous physical and chemical characteristics have been learned, the following step is that of selecting that class of crude oils from which the best grades of Burning Oil stocks may be obtained.

Selection of Crudes

If we glance once more at the specifications which the finished oils must meet it will be seen that the sulphur content must be at a minimum. The presence of that element in crude oils seems to give more trouble than any other element, no doubt, due to the fact that it has such a detrimental effect on the burning test when present to any degree in the stock, and is so difficult to remove.

Therefore, in selecting a crude oil for Burning Oil Stocks, the sulphur content of the crude should be low. Some crude oils from which the stocks have been obtained are practically void of sulphur, such as Pennsylvania oils, Eureka and Morgantown. These crude oils contain less sulphur than the specifications call for in the finished burning oils themselves. Such crudes, undoubtedly, would yield the best stocks, but since the supply is limited, it has been necessary to call upon other sources. The next best type of crude oil, apparently, is the coking crude, and in this class may be included Haynesville, Powell, Mexia and Somerset crudes.

An analysis of these oils shows that each has a sulphur content of approximately .28 per cent, with the one exception of Haynesville, which runs approximately .45-.55 per cent sulphur content. Each of the above crudes yields a comparatively high percentage assay distillation yield over at 608 degrees F., the average being 58 per cent. The average gravity, too, of these crudes (with the exception of Haynesville) is approximately 36.6 degrees Be.

Perhaps the method of running the crudes has helped to determine their selection as much as the nature of the crudes themselves. However, it must be acknowledged that the low sulphur content is the prime factor. Now we arrive at the distillation of the crude oils for Burning Oil Stocks.

Distillation of Crude Oils

Since we are interested primarily in light end running, I deem it unnecessary to go into full detail with regard to running to coke. Therefore, the following chart will lend sufficient information in order to obtain the desired Burning Oil Distillates. Assuming that we are running to coke, the following procedure should be carried out.

From the above flow chart it will be seen that from the heavy crude naphtha cut, water white stock is obtained, and from the sour distillate cut, standard white stock is likewise obtained. These represent two of the most important distillates in the manufacture of Burning Oils.

On fractionating the heavy crude naphtha for water white distillate the gravity of the distillate was 43.8 degrees Be. and gave the following assay distillation. Likewise the assay distillation of the sour distillate was as follows:

Water White Distillates	Sour Distillates
Grav.—43.8° Be.	37° Be.
Over— 278° F.	276° F.
Dry — 600° F.	721° F.
302— 2	——
338— 8	5
356—14	9
374—21	10
410—36	15
500—80	35
536—91	50
600—98	74

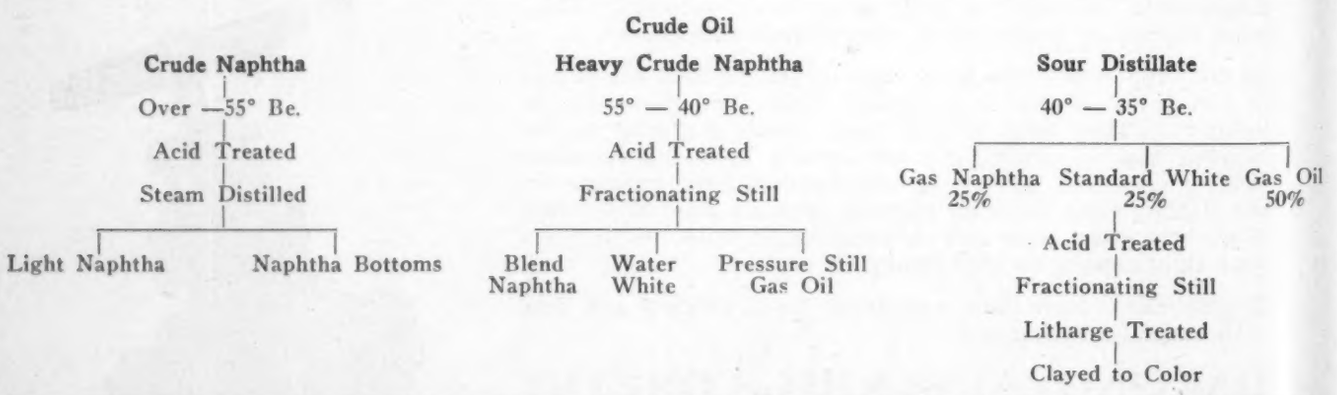
On rerunning sour distillate for standard white distillate, a cut was made between 374 degrees and 608 degrees F. which represented the desired cut. The distillation results of the standard white cut I shall omit except to mention that the percent over at 410 degrees F. was 36.5 which comes within the specification for this particular grade of oil. In other words, the controlling specification for this distillate is the percent over at 410. F. The above procedure will suffice to illustrate how the remainder of the burning oils heretofore mentioned may be made, namely, by running to the gravities required by their respective specifications. Before concluding the work on distillation it may be of interest to note that approximately 58.0 per cent of kerosene stock is obtained by rerunning the standard white distillate. In making this distillation, an overhead cut is obtained, called blend naphtha, which is often used in raising the gravity and bettering the assay distillation of the finished burning oil. This cut is made between the temperatures 314 degrees and 410 degrees and possesses the following tests.

Grav. . .....44.6°
Over Point 370
Dry Point 421
50% over at 378

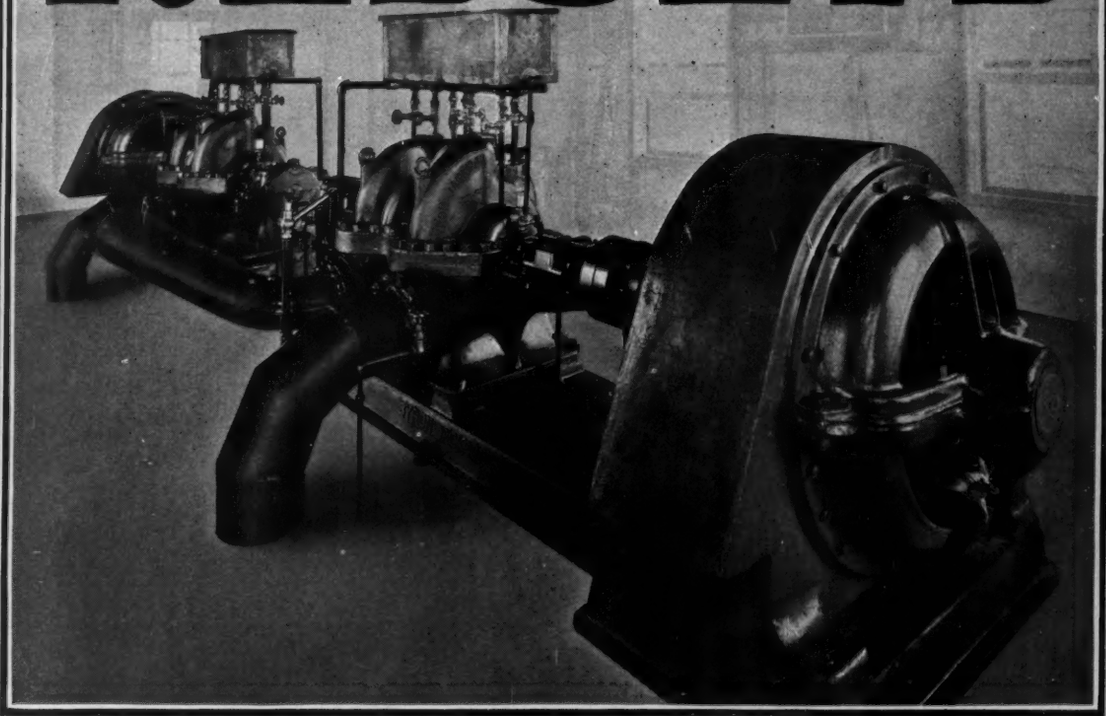
This brings the processing to the next step in refining, namely, sulphuric acid treating of the above distillates.

Acid Treatment

In the discussion on the acid treat-



RESULTS



[Byron Jackson Installation Oklahoma Pipe Line Company, Henryetta, Oklahoma]

Centrifugal Oil Pipe Line Pumps

In one station 40,000 bbls. a day pumped against 700 lbs. pressure for a total cost of $4.61 per 1000 bbls. This comprises all station costs, including interest and depreciation on investment, taxes, insurance, repair and maintenance, attendance, power, lubricating oil, etc.

Engineers recognize that centrifugal pumps, because of their non-pulsating flow, deliver more oil through a given line at a given pressure than reciprocating pumps.

These facts are substantiated by the experience of numerous stations. Write us for illustrated literature.

SINCE 1872

BYRON JACKSON PUMP MANUFACTURING COMPANY

FACTORIES: BERKELEY, LOS ANGELES, VISALIA

Branches: San Francisco, Portland, Salt Lake, Dallas, Phoenix

BYRON JACKSON

CENTRIFUGAL PUMPS FOR EVERY SERVICE

ment of burning oil distillates, many interesting as well as vital questions have arisen. They are not theoretical or technical points in the true sense of the word, but are practical to a large degree. It is remarkable how closely allied the chemical end of petroleum refining is becoming with the plant manufacturing end. To further illustrate this I shall outline various important questions which the plant operators or engineers, and even superintendents of individual departments have so thoughtfully asked. These questions pertain to acid treatment, neutralization, doctoring, distillation, and filtering of the distillates under discussion. They are:

1. What is the best temperature at which to acid treat?

2. What is the effect of varying temperatures upon the sludge formed?

3. What strength acid (H2S04) gives the best treating results?

4. What quantity of acid used gives the best color?

5. What strength caustic soda is best for neutralization?

6. What should be the percentage litharge in Doctor's Solution?

7. What percentage sulhpur oil should be used to break the doctored oil?

8. What practical method can be appiled to use less acid and yet obtain desired treating results?

Each question involves a definite plant operation and yet carries with it a chemical thought, and incidentally a chemical reaction. The latter I shall endeavor to make more clear a little farther on.

The type of agitator used for acid treating is identical with the ordinary covered treating agitator equipped with an air line at the bottom of the agitator, an acid line, a charging line for the distillate, and an acid sludge draw-off valve at the bottom of same agitator. In some refineries an entirely closed and circulating acid treating unit is used in which the treating loss is reduced to a minimum. In either case the acid is added while the oil is agitating. Since the question of temperature is the first in the list to be answered, it may be stated that on running numerous plant treats between the temperatures of 50 degrees F. and 100 degrees F. the best treating temperature range was found to be 85 to 90 degrees F. The color of the oil was good.

In answer to question No. 2 it was found that at any temperature between 50 degrees F. and 100 degrees F. apparently little change was noticed in either the color or nature of the sludge since the latter, (acid sludge), could be easily handled in the plant.

It is always of interest to the refiner in endeavoring to cut the cost of production, by either changing the method of processing or by devising a means by which the use of less chemicals might be used, to obtain as good or even better results. With this in mind it was desired to ascertain first, what minimum strength acid could be used successfully and second, the minimum quantity which would give the best color to the finished product. The oil to be treated was freed from its moisture by being given a cutter, agitated ten minutes, allowed to settle 30 minutes, and then the acid sludge drawn off. The temperature of the oil before treating was 86 degrees F. Upon removal of the sludge, sulphuric acid to the extent of 16.84 pounds per 100 barrels was added to the oil and the contents of the agitator blown for 30 minutes, allowed to settle 45 minutes, and then the sludge drawn off.

After the sour oil had settled for one-half, one, one and one-half and two hours time, a titration for acidity at the end of each period was made and found to be 10 c.c., 9 c.c., 7 c.c. and 6.8 c.c. respectively per 100 c.c. of sour oil. The strength of alkali used was tenth normal (N/10 NaoH), caustic soda. By using eight varying strengths of acid ranging from 65.-93. per cent sulphuric acid content it was learned that the best results were obtained by using 93.0 per cent H2S04, to the extent mentioned above. An analysis of the sludge showed that where the higher percentages of acid were used the greater the tar contents (Benzol Soluble) and the greater the percentage of insoluble matter. Hence, in answer to questions Nos. 3 and 4 it may be concluded that it is inadvisable to use acid for treating below a 93. per cent H2S04 content and the amount of acid used should be at least four carboys per 100 barrels of oil treated. The next step in refining is that of neutralization of sour oil. To decrease the acidity of the oil a water wash, approximately 25 per cent by volume, may be given the oil advantageously.

Neutralization of Sour Oil

From titration figures it may be easily determined how much caustic soda will be necessary to neutralize the batch of oil treated. In order to insure neutrality a 5 per cent excess is added and the contents agitated for approximately 20 to 30 minutes with air. At the termination of this time, the soaps and spent caustic soda should be drawn off and the oil tested for a slight alkilinity. If the test proves positive, the oil should be washed with approximately 25 per cent by volume of water, agitating during the addition of same, settled three-fourths hour and then the wash drawn off. At this stage, the oil is ready for the fractionating still. The average N. P. A. color of the oil so far treated will range from 1¼ to 1¾. Eight degree Be gravity caustic soda was found to be the best strength for plant work.

Fractional Distillation

The type of still used for this purpose is that of the ordinary fire and steam, equipped with a fractionating column to insure close cutting. In some instances a dephlegmating column is used with a run-back line to the still thereby insuring a much closer fractionation with the elimination of the heavy ends of each cut. The charging stock for the distillation will be approximately 39.0 degrees Be. gravity and will have an over point of about 330 to 340 degrees F. with a dry point of about 630 to 640 degrees F. The sulphur content will be approximately .220 to .250 per cent.

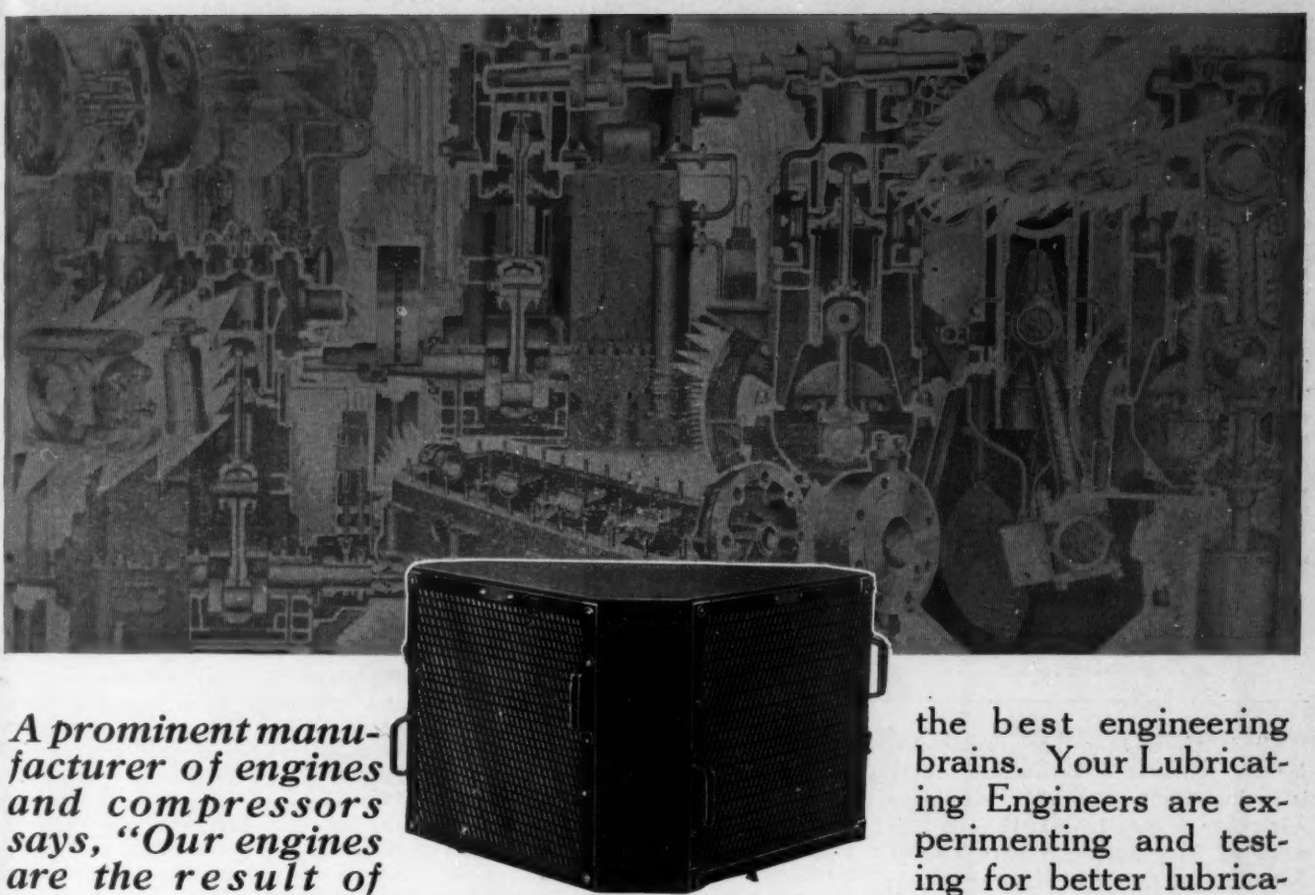
The overhead cut in which we are particularly interested is that between the temperatures of 374 and 536 degrees F. This cut will vary as to gravity according to that of the charging stock. It is always helpful to the stillman to know the assay distillation of the charge. When the temperature of the still has reached approximately 480 to 490 degrees F. steam may be admitted sufficient in amount to keep the vapors (as formed) moving in the direction of the condenser. By all means, every precaution should be taken to prevent cracking. In a distillation of this nature there is not much trouble experienced so long as the temperature element is controlled. Almost without exception the gravity of the overhead cut from 374 to 536 degrees F. will fall between 40.0 and 41.5 Be. The color will have been considerably improved, changing from approximately 1¼ to 1¾ N. P. A. to approximately ½ to ¾ N. P. A. On assay distillation the average percentage over at 500 degrees F. will be 85.

Litharge Sweetening

A name often applied in this procedure is "Doctoring." Of all the chemical reactions so far involved, the sweetening of the oil with Doctor's Solution is undoubtedly the most complicated. The significance of this reaction is to change sulphur in its initial form, which, heretofore, was unaffected during processing. The treatment of the element, sulphur, which seems to give the most trouble in souring of the oil is made possible by dissolving litharge (Pb0) in caustic soda to give sodium plumbite, and subjecting this to oil with vigorous agitation. Various strengths of sodium plumbite, (Doctor's Solution) have been used to take care of this undesirable element in the oil, ranging from 15 to 24 degree Be. gravity. The best results have been obtained by using a solution containing 1.87 per cent lead and having a gravity of 22 degrees Be. The process is carried out by agitating the oil with air at the same time adding the plumbite solution. The length of time blowing is 15 to 20 minutes. The contents of the agitator are allowed to settle long enough to cause the spent Doctor Solution to settle completely to the bottom of the agitator, at which time it is drawn off and retained for further use.

The chemical reaction which repre-

PROTECTION



A prominent manufacturer of engines and compressors says, "Our engines are the result of years of experience coupled with a careful study of actual operating conditions in all parts of the country by engineers who are specialists in the construction and care of engines."

How About the Air Intake?

Manufacturers are spending time and money for the best materials—for the best engineering brains. Your Lubricating Engineers are experimenting and testing for better lubrication to prolong the life of your equipment—all the gates are closed but one . . . the air intake.

A Reed Air Filter installed on the intake of an engine or compressor removes 97% of all dust, dirt, and grit from the air—it prolongs the life of your equipment—it pays.

REED AIR FILTER COMPANY, INC.
Louisville, Ky.

Distributed to the Oil Industry by

SMITH SEPARATOR COMPANY
Tulsa Okla.

Texas Offices:
924 Post-Dispatch Bldg.,
Houston, Texas

1402 Ft. Worth Natl. Bank Bldg.
Fort Worth, Texas

Louisiana Office:
405 Forest Ave.,
Shreveport, La.

California Office:
2039 East 38th St.,
Los Angeles, Calif.

Mention Where You Saw the Advertisement

sents the above change may be expressed as follows:

No. 1

$$\begin{matrix} R-SH \\ R-SH \end{matrix} + \begin{matrix} NA-O \\ NA-O \end{matrix} >Pb= \begin{matrix} R-S \\ R-S \end{matrix} >Pb + 2\ NA\ OH.$$

Alkyl Mercaptan — Sodium Plumbite — Lead Mercaptide (Suspended ppt.) — Sodium Hydroxide

R = Radical (C2H5, C3H7, C4H9, etc.)

It is apparent that the sulphur in the oil is combined. However, it may be possible that on account of litharge (Pb0) being an oxidizing agent, oxidation likewise takes place. In such a case the sulphur would undoubtedly react with the sodium plumbite to give a black precipitate of lead sulphide (PbS). Hydrogen sulphide will react with Doctor's Solution to give black lead sulphide. And now we introduce another important chemical reaction, the significance of which is to break the doctor treatment causing the precipitation of black lead sulphide (PbS) which is commonly called Black Strap. The reaction is as follows:

No. 2

$$\begin{matrix} R-S \\ R-S \end{matrix} >Pb + S = \begin{matrix} R-S \\ R-S \end{matrix} + PbS$$

Alkyl Disulphide — Black PH.

Alkyl Mercaptans are responsible for the sourness in kerosenes. There is an important point which should be remembered, namely, that the alkyl disulphide does not react with Doctor Solution, and therefore remains soluble in the oil. Sulphur oil was prepared by mixing free sulphur with unsweetened oil to give a saturated solution. Five per cent by volume of the sulphur-saturated oil was added to the doctored oil in order to insure a break. It was interesting from a quantitative standpoint to determine just how much lead was used (removed from the Doctor's Solution) in the sweetening process. The average of the treats showed that one-half of the lead was used in sweetennig the oil. After breaking the Doctor the contents of the agitator were allowed to stand 2 hours at which time black strap was drawn off and retained for further recovery. In breaking the above doctored oils it was found that 5 per cent by volume of sulphur oil was insufficient to give a break, therefore, it was necessary to add more. On the average, however, 5 per cent by volume of sulphur was found sufficient to break the doctor. The final step in refining burning oils is that of filtering to color.

Filtering to Color

In the majority of cases, No. 1 clay is used in this process. However, with the introduction of new and better methods of burning clay, it is possible to obtain high filtering yields with clays which have been burned several times.

The method of preparing and charging the filter is identical with that described in the concluding article on "Wax and Its Manufacture" published in the January issue of this journal. Hence, it will not be necessary to go into detail regarding this. When the oil first comes through the filter it has a color of about +24 Saybolt or better, but soon drops off in color the faster and longer the filter runs. Since various grades of burning oils have different colors specifications it is only a matter of running into a tank from the first oil through the filter until an average sample of the tank shows the color desired. The color specifications range from +12 to +25 Saybolt, the latter color representing Water White.

As an arbitrary figure, say 200 grams of clay, an average filtering yield should give about 8,500 c.c. of oil filtered to +12 color Saybolt. From this result it can easily be figured how many barrels of oil per ton of clay may be filtered to give this color. The color of the average grades of burning oils(kerosenes) runs about +16 Saybolt. The filtering yield in this instance will not be as high as in the former. It may be mentioned that the color of the oil is no criterion of the quality of the oil.

The burning properties of the oil are really what count. A finished oil of this nature will have a flash point of 140 to 150 degrees Abel; an average overhead point of 355 to 360 degrees F.; a viscosity of approximately 435 to 450 at 60 degrees F.; an average dry point of 550 degrees F.; and an average sulphur content of approximately .06 to .10 per cent.

There remains but one question unanswered—No. 8. It was mentioned earlier in this article it is of interest to every petroleum refiner to devise some means whereby it may be possible to cut down the amount of chemicals used in operation. Therefore, to endeavor to save acid the following procedure was carried out. Since the acid and oil in treating are together for such a relatively short period of time there cannot be much expenditure of acid. This was determined by titrating the acid sludges from several Kerolite treats and finding that the average acidities to be 70 per centH_2S0_4 content. The average percentage of insoluble matter was found to be 2 per cent and the percentage benzol soluble 3.0 to 4.5. The gravities of the various sludges averaged 56.0 degrees Be.

Sludges from standard white treating analyzed according to the following: Average Be. gravity—42.0; average H_2S0_4 content—47.0 per cent; average insoluble matter—1.45 per cent; average Benzol Soluble—15 per cent. It was endeavored to use again the above sludges, (together with sufficient 93.0 per cent H_2S0_4 to bring the actual acid content up to the straight 93.0 per cent H_2S0_4 content) in treating new stocks. Unsatisfactory results were obtained on the burning oil stocks, but by treating light stocks, such as gas, naphtha and gasolines good results were obtained. Several practical plant applications of this idea are now in use.

Western Petroleum Refiners Association to Meet at Kansas City, March 6

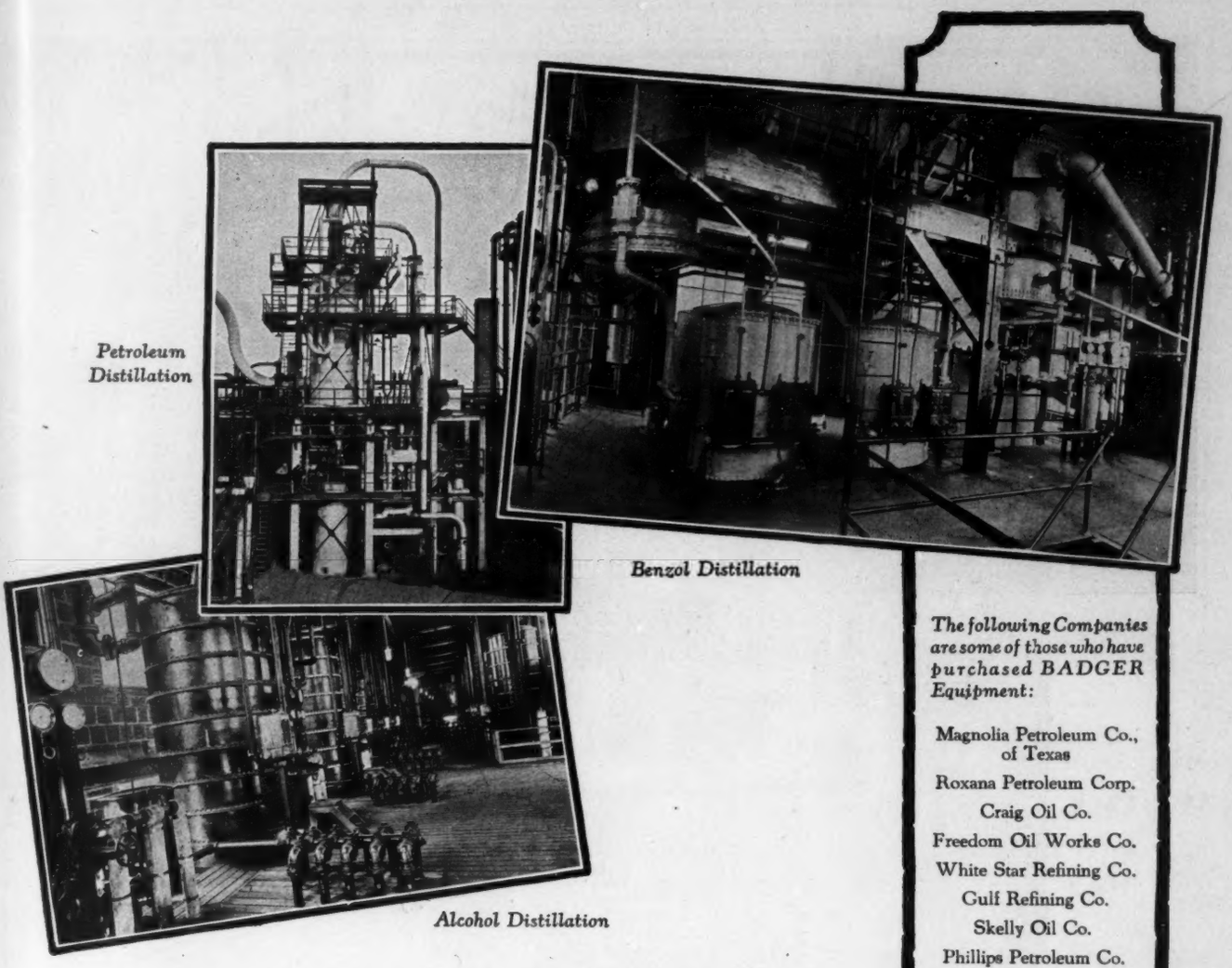
TULSA, OKLAHOMA.—The annual meeting of the Western Petroleum Refiners Association will be held at the Muehlbach hotel, Kansas City, Missouri, March 6.

The one-day meeting is the second consecutive session of that duration. It will be a meeting to consider executive problems and for the election of officials and directors. In 1927 the organization adopted a policy of having the annual convention of just one day, eliminating sessions devoted to technical, sales and traffic subjects. Technical sessions are held in different refining centers during each year.

The announcement of the meeting reads:

"This meeting, aside from the election of officers and directors, will be devoted entirely to a round table discussion of problems of the Mid-Continent group of refineries. During periods when conditions of the industry at large are none too favorable it is important that policies of individual plants should be based on a careful analysis of conditions and even the best informed can profit from a more intimate knowledge of affairs within the province of his own organization.

"We believe, in view of the extreme caution with which 1928 must be viewed by all refiners, that each member company of our association should have executive representation at the annual meeting next March."



Petroleum Distillation

Benzol Distillation

Alcohol Distillation

Badger Experience in Distillation

E. B. BADGER & SONS COMPANY have constructed distillation equipment for more than fifty years.

Badger engineers have made a particular study of the theory and practice of fractional distillation for more than twenty years, and have been responsible for the development of the most efficient equipment in use in many industries today.

The Petroleum Industry was slow to appreciate that exactly the same practice governed the fractionation of petroleum as of other volatile materials, but now concedes this to be true.

Badger Petroleum Fractionation Equipment is the product of an organization having far greater experience in the field of general distillation than any other concern in the United States, and this experience is responsible for the efficiency of Badger Systems.

The following Companies are some of those who have purchased BADGER Equipment:

Magnolia Petroleum Co., of Texas
Roxana Petroleum Corp.
Craig Oil Co.
Freedom Oil Works Co.
White Star Refining Co.
Gulf Refining Co.
Skelly Oil Co.
Phillips Petroleum Co.
Pierce Petroleum Corp.
Tide Water Oil Co.
Anglo-Persian Oil Co., Ltd.
Empire Refineries, Inc.
Marland Oil Co.
Vacuum Oil Co.
Associated Oil Co.
Barnsdall Corp.
Humble Oil & Refining Co.
Tidal Refining Co.
Standard Oil Co., of N. J.
General Petroleum Corp.
Beacon Oil Company
Lubrite Refining Co.
Pennzoil Company
Shell Company of California

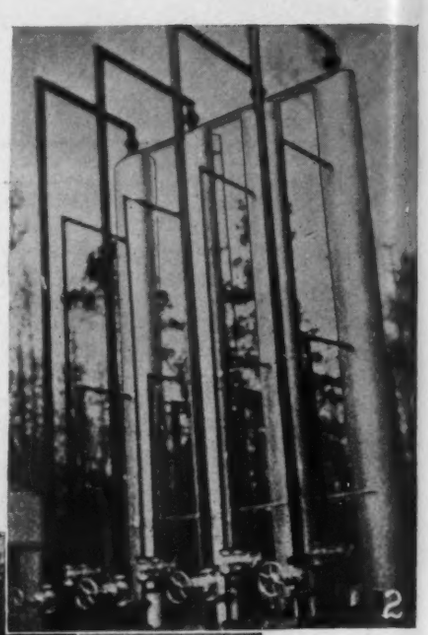
E. B. BADGER & SONS COMPANY

New York • Kansas City • Tulsa • Los Angeles • Ann Arbor • Boston

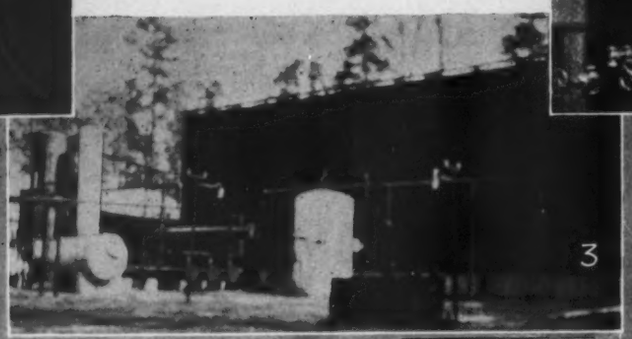
Mention Where You Saw the Advertisement

Cotton Valley Gasoline Plant *of* The Palmer Corporation In Pictures

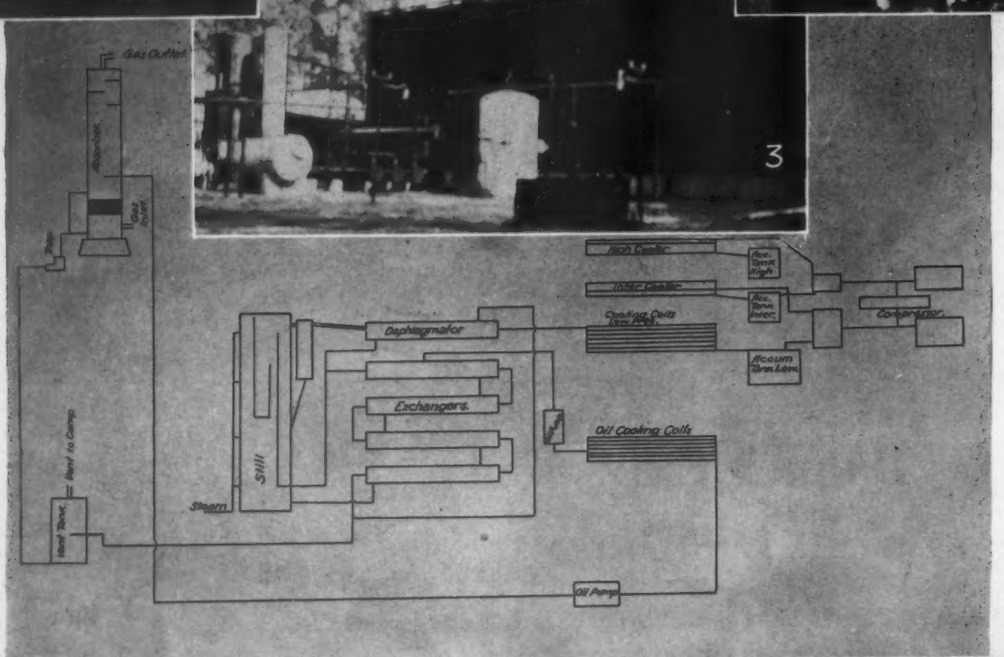
1



2

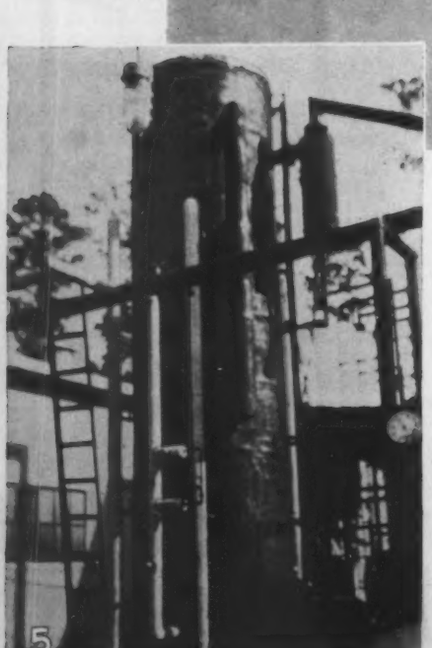


3

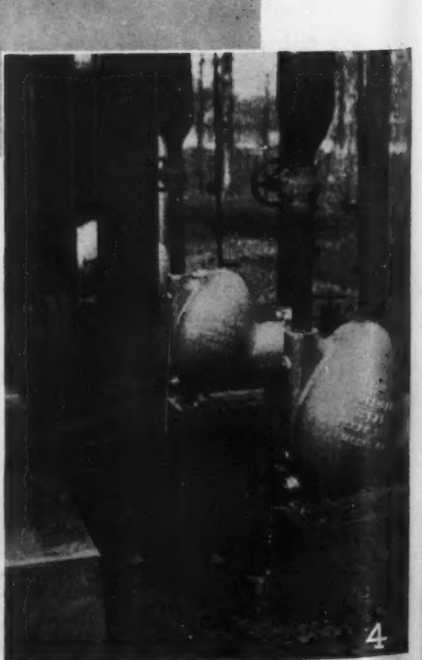


FLOW SHEET
Cotton Valley Gasoline Plant
The Palmer Corporation
Of Louisiana.

6



5



4

1—*Heat exchanger and dephlegmator equipment. Efficiency makes the usual preheater equipment unnecessary.*

2—*Absorbers hooked up in series of two, through which absorption oil is circulated at the rate of 1000 gallons per hour in the first towers in the series, and 500 gallons per hour through the second or "re-run" absorbers.*

3—*View of Palmer Corporation's Cotton Valley absorption gasoline plant showing assembly of equipment and convenient type of lay-out.*

4—*Traps installed on saturated oil outlet lines from absorber towers.*

5—*Newton type distillation unit in operation at Palmer Corporation's Cotton Valley plant.*

6—*Flow sheet.*

They Delivered Oil in Half-Pints Then

Now 160,000 Half-Pints Are Carried in a Single Tank Car

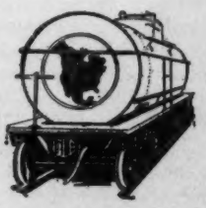
In the early days of the petroleum industry, the chief function of crude oil, aside from its illuminating duties, was its use as a panacea—a marvelous medicine guaranteed to cure anything from baby's croup to barber's itch, not to mention painter's colic and writer's cramp.

Sales were great but quantities comparatively small. Deliveries were made in half-pint units.

Consider the difference in the situation today—with single tank cars regularly carrying 10,000 gallons!

The manner in which tank cars have met the tremendous demands placed upon them in recent years is one of the outstanding developments in transportation—a development in which the private car builder and lessor has played a most important part.

It is the stabilizing influence of tank car leasing that minimizes the losses of seasonal variation in gallonage; that enables the shipper of liquids to have the full use of cars without paying for the periods in which he does not use them, without the heavy capital investment that ownership entails, and without interest, taxes, depreciation or obsolescence to contend with.



North American leasing was founded on experience, and is grounded in service. We invite you to get in touch with us.

NORTH AMERICAN CAR CORPORATION, 327 S. La Salle St., Chicago, Ill.

North American

CAR LEASING SERVICE

Mention Where You Saw the Advertisement

Modern Practice in Refining Lubricants*

By C. B. FAUGHT
Refining Superintendent, Texas Pacific Coal & Oil Co.

IN making this talk to you men, I am keeping in mind the fact the majority of you, like myself, are stockholders in the company. Those things that affect our plant likewise affect you. For this reason, we have chosen to give you the opportunity of considering with us the problems that confront the modern refinery. Naturally, there will not be time to go into detail on every question that is of interest to you, but the fundamentals will be discussed.

The progress that has been made in the manufacture of lubricating oil has been rapid. Since the world war, refining practice has had some revolutionary changes. This has been brought about by just one thing: necessity. The demand for better lubrication followed advancement in the mechanical fields. High speed automobile engines, air-cooled airplane motors, new machinery; these and countless other factors have brought a demand for something better than filtered cylinder oil, red engine oil, low flash or highly volatile motor oils, high end point, improperly fractioned gasoline and blue tinted kerosene.

It has ceased to be sufficient for the refiner to blend a low viscosity neutral with a high viscosity cylinder stock to produce a stable lubricant. We have found by extensive experiments that the motor oil which stands up under service best is that oil which most nearly contains the whole lubricating stock just as it occurs in the crude. Or, in other words, straight, reduced, unblended stocks or heavy neutrals blended with an 80/90 or 120/130 viscosity @ 210 stock. This gives the flexibility of manufacture necessary to economically produce the entire line of motor oils in common use today.

Ever Changing

Tomorrow will bring greater advancement. We are looking forward to and preparing for the time.

What has been the answer of the refiner to the demand for better lubrication?

The chemical and mechanical engineers have been called in and given a voice in all progressive refineries.

The results have been startling. So much the more so since the art of refining had been long considered something mysterious. A few old heads knew how, but seldom why, certain procedure should be followed. Their secrets were carefully guarded, and even the employer often did not know what was being done in the plant. This was true in each department. This secrecy has been removed. Very definite physical and chemical laws were found to control the proper refining of oil from the crude to the many finished products.

Many precedents have been reversed, and about-face methods substituted. It has been a tedious and often stormy and thankless job to get these ideas over, but the results have been gratifying.

These changes in precedents can be traced through each department.

Let us begin with the crude battery. This is recognized as the heart of the refinery. It is here that the quality of the finished oil is determined. No amount of acid treating or contacting or percolating or dewaxing can correct mistakes made by you men who operate the crude battery.

Old Time Stuff

Look back ten years. Even as late as 1917 a plant was fortunate which had three men on the same battery with the same ideas. One man spent a large part of his shift time trying to correct what he considered the mistakes made by the man he relieved. He had his own ideas as to the temperatures on the stills. Uniform temperatures were not considered so important. At one plant where I worked, one battery of six crude stills was operated without even an angle thermometer. The stillman judged his temperatures mostly by spitting on the uninsulated shell to "hear how it sizzled." Most of you old-timers remember those days when you made your cuts by feeling the oil between your thumb and forefinger for viscosity. If it 'smelled" and "felt" right, you cut accordingly. You did not know much about fractionating towers, and it mattered little about costs of re-running. Practically all gasoline and kerosene had to be re-distilled and acid treated. It took you a long time to get your education when you were a helper, because the stillman passed out very little of his precious knowledge.

What a marked change has taken place!

Where shell stills are used, they are carefully insulated and equipped with both angle and recording thermometers. Your streams are fractionated in towers designed scientifically to meet the needs of each particular crude. Your fireboxes are equipped with air preheaters and fuel consumption is carefully checked. Combustion boxes have been installed to give complete combustion without convextion heat, where radiant heat is found to better serve the purpose. Your towers are kept at constant, pre-determined temperatures by automatic temperature control equipment. Your streams are uniform 24 hours of the day and you do not have to re-run or acid treat your gasoline or kerosene. You have great flexibility with your towers so that you can make one of several products, according to market demands. You do not make any off cuts that have to be re-distilled or thrown into slop.

This mechanical control with recording instruments, together with laboratory checking, enables the superintendent and foremen to know what has been done every hour of the day and night. It gives you definite knowledge of what you are doing. We tell you what temperature to carry and that is all you have to worry about. Your results are uniform and the guess work has been removed. When a problem arises, a chemical engineer is called and the reason for the trouble is soon found. This is an opportunity for those of you who do not have this specialized training to learn the facts that control these basic principles. We have these men on the plant because they can help us. In helping us, they help you.

Secret Out of Treating

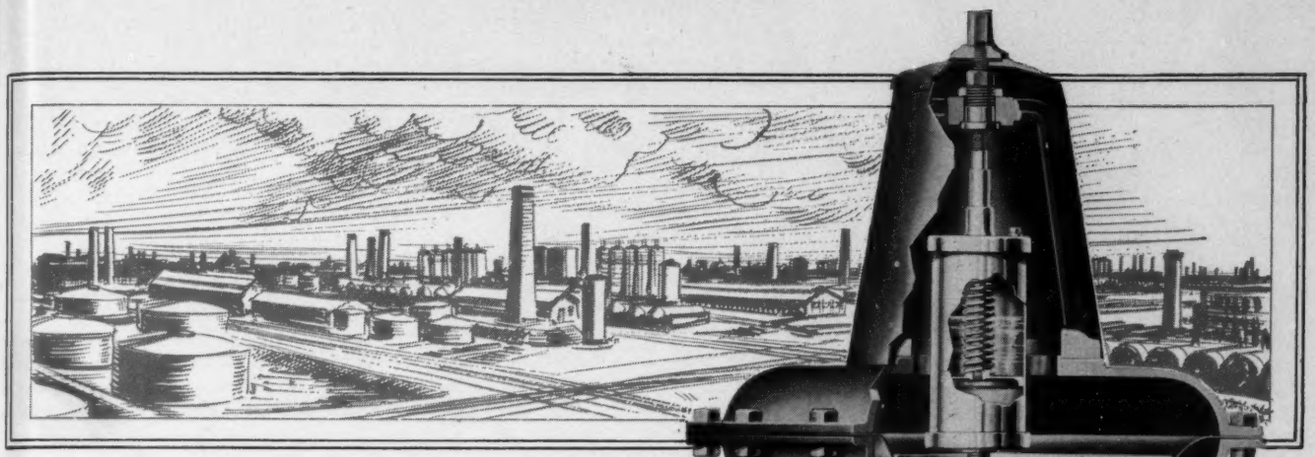
Likewise, treating methods have changed. No longer does the treater go "on top" and hope for a good break, while his helper stays below and waits for the time when the treater will tell him the secret and let him go up too.

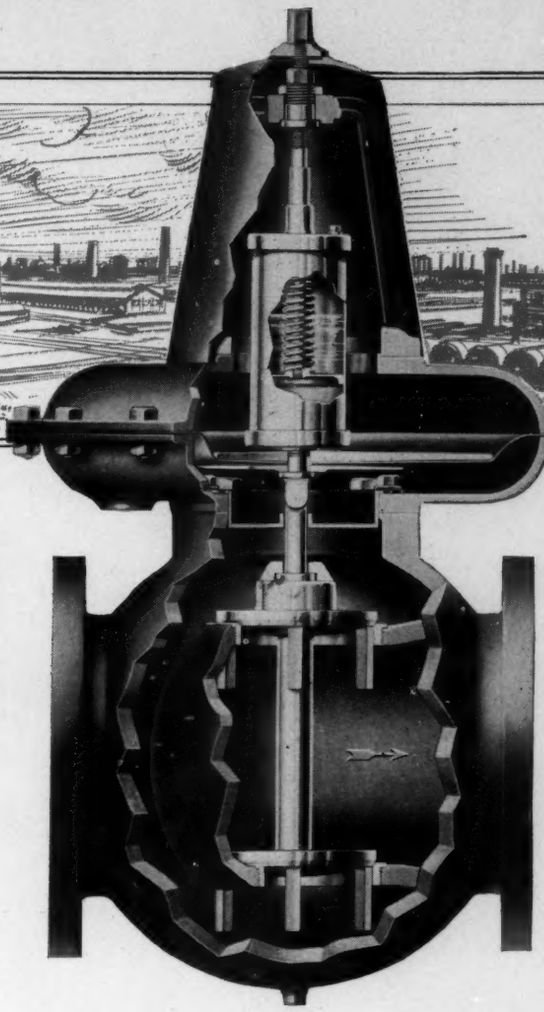
We have established all these facts, and have taken the secret out of treating. We have found our correct treating temperature and have a constant check by using a recording thermometer on the acid agitator. Definite conditions give definite results. We create those conditions for you and know you will get the results we want.

In our plant, the steps following the acid treat are somewhat different from those of ten years ago.

Instead of neutralizing and washing, we hot settle out the fine pepper sludge left after the break, and pump this sludge-free oil to the contact plant where decolorizing and neutralizing is done in one step. The oil is mixed with a calculated amount of clay pump, thoroughly agitated and pumped through a pipe still. This removes the water, neutralizes and decolorizes the oil. It is then blended with 50 per cent of naphtha and run through a Sweetland Press, which is equipped with monel metal leaves. This removes all clay, following which the oil is further diluted and dewaxed. Here again, in contacting, the use of recording instruments gives us a record of temperatures, time and pressures. No vital step is left unguarded.

*Read before employes of the Texas Pacific Coal & Oil Company refinery, January 18, Fort Worth, Texas.





Modern Refiners are gathering their vapors

with Davis supersensitive Relief valves

It is becoming more and more the practice of modern refiners to install gas gathering systems and convert vapors formerly wasted into gasoline. Vapors are gathered from storage tanks, look boxes, still headers, and other points.

The DAVIS Supersensitive Relief Valve is an indispensable adjunct in connection with such systems. Its function is to hold back very light pressures, and prevent the system from putting a vacuum on the tanks, etc. The operation of the valve is controlled entirely by the inlet pressure, and is not affected by the vacuum in the outlet line.

This valve can maintain atmospheric pressure on the tanks, or a few inches of water pressure, as desired. It is accurate, dependable, and durable. An oil dash pot steadies the action, positively preventing chattering.

Call on our staff of engineers for solving your problems involving measurement and control of gases and liquids.

WESTCOTT & GREIS, Inc.

Dallas **Tulsa** **Los Angeles**

WESTCOTT & GREIS

MEASUREMENT AND CONTROL

Mention Where You Saw the Advertisement

The dewaxing plant offers an interesting contrast to the old method of wax removal.

The refrigeration is done in our 158 ton ammonia compression plant and the rate of chilling is carefully controlled so that all the waxes are left in the proper formation and condition for removal. This is a very important factor in wax removal, but can be easily controlled. After the oil solution has been chilled to —15 degrees, it is dewaxed by feeding the chilled solution through the battery of twenty Sharples Super-Centrifuges. These machines have been tranformed from a cream and milk proposition to a remover of the enemy of proper lubrication, paraffin wax. We have been able to so control our procedure that we have produced the first zero cold test filtered Bright Stocks on a commercial basis. This is considered as one of the outstanding accomplishments in the manufacture of lubricating oils.

Science in Grease Making

This does not close the story of progress. The diluted, dewaxed oil is then charged back to the reducing stills where the naphtha is removed and the neutrals are taken out of the treated, dewaxed stock, in the reduction of the stock to the desired specifications. This gives a neutral with a 25-30 cold test of 200 to 240 at 100 viscosity and of 2½ to 3 color. No further refining of the neutral is necessary, with the exception of reducing it for flash and viscosity. This reducing process does not cause a loss of color of either stock or neutral.

The last step to be considered is not the least in importance. That is the manufacture of grease. For many years, this has been a carefully guarded secret. Probably the most difficult to solve of all our problems. However, we have found that the same definite underlying principles govern the successful making of greases that makes possible the accuracy in other departments of the plant. There are definite things that we have found give us perfect results. We follow them and our greases are uniform, batch after batch. We do not consider that we have any secrets here, as cause and effect are so definite. It has been reduced to a routine that could be learned in a very short time by any man of ordinary intelligence. Here again chemical knowledge has replaced the personal element, and has produced a better, more uniform product.

In summing up these remarks, I would say that close observance of the instructions issued to you men has been the big factor in our progress. Our future progress will depend largely on your continued close co-operation.

This review of progress is recounted to impress upon each one of you the necessity for strict following of our orders. We have learned the reasons why exact procedures give difinite results. You do not have to depend on your own judgment in handling our equipment. There are definite things happening inside your stills and agitators, your clay mixers, your dewaxing plant and your grease kettles. The point to absorb is that when you know that this is true, then you are able to understand the importance of using utmost care each minute of the time you are on duty.

Consider these points carefully then, and absorb all the information you can, because, in so doing, you make your work easier and give us better products.

Life of Mechanical Equipment*

By R. BEATTIE,
Chief Engineer, Texas Pacific Coal & Oil Company

A GLANCE at the title will immediately raise in the mind of the reader the question, "This is a big subject for a small paper." To go into minute detail in every phase of a widely disseminated subject, such as the above, would indeed involve a lengthy discussion. However, such is not the author's intent. A survey of conditions and problems confronting the mechanical department, considered from a more or less general viewpoint, is what is intended, with special emphasis on the effect of the attitude of the man at the throttle, to speak figuratively.

The life of mechanical equipment is, to an astonishing extent, due to the treatment it receives by the operator. A very striking example of this truth could have been seen a few weeks ago on the streets of Fort Worth. You will recall the pioneer's automobile parade. Some of the machines entered were of the vintage of 1904. Automobiles are the worst example of ill-treated machinery we have in this country today, and by far the most common. No less an authority than Mr. Sloan, now president of the General Motors Company, is responsible for the statement that the average life of a modern automobile is two years. The possible life of the modern car is eight years, with proper treatment.. If it were not for the constantly changing body styles and continuously increased efficiency, the production of cars could be cut down 300 per cent. With proper care, the car you bought this year would be junked in 1936.

I quote this common example to bring to your attention just how important a part in the final balance sheet the attitude of the operator plays. For the benefit of operating men here or men who have mechanical equipment under their supervision, let us analyze just how this attitude reflects on the operator.

The Executive's Viewpoint

In the first place, the management probably keeps a repair cost record. Any serious break or excessive repair cost is bound, sooner or later, to be called to the attention of some one of your superiors. Such a condition cannot help but reflect on the man or men responsible. Secondly, inefficient operation, while perhaps not being detrimental to the equipment itself, is bound to affect, sooner or later, the quality of work performed. This is again checked up by superiors and, in turn, reflects to the discredit of the operator.

Now imagine yourself in the executive's chair for a moment. You have no time for details. You cannot personally supervision the operations, of starting and stopping pumps, motors, compressors, etc. It is necessary that you gauge a man's proficiency in terms of costs and results. Considering all these things then, should a report come to you that a pump had "run away" and was damaged to such an extent as to involve a large repair bill, the first question that would come to your mind would be, "Was the man on the job?" and, to be truthful, nine times out of ten, the man wouldn't be "on the job." So you see, again, that while perhaps you, as an operator, would have a logical explanation, the odds are against you. An excellent argument for increased attention.

To become a little more concrete and bring this discussion home, let us consider in terms of money just how much responsibility we have on our shoulders. In round numbers, this plant represents an investment of, say, $1,500,000. The real estate can be figured at $300,000. The balance, $1,200,000, represents buildings and refinery equipment. Allowing $100,000 for buildings and $100,000 for miscellaneous items, we have left $1,000,000 worth of tanks, stills, boilers, compressors, pumps, motors, elevators, pulverizers, mechanical shops and trucks, all of which belongs, broadly speaking, in the category of mechanical equipment. You are directly responsible for the life of this equipment. Now apply the statement of Mr. Sloan, of the General

*Paper read before plan school of Texas Pacific Coal & Oil Company refinery, Fort Worth, Texas, January 24, 1928.

Flashing

There are no additional royalties connected with the installation of the Flashing System in a Dubbs Cracking Unit

The cost of its installation is very low; its returns very high

Universal Oil Products Co
Chicago, Illinois

Dubbs Cracking Process
Owner and Licensor

Motors Company, to this million dollar investment, and it is very strikingly brought home to you just what care and attention means to the company.

An Abused Product

Having spoken so far in generalities, let us get down to a few major details. How does lack of attention affect the life of mechanical and electrical equipment?

Why does ill treatment cut down the life of, say, a pump? And how can such conditions be remedied to the advantage of the employees and the employer?

For example, let us take the commonest piece of equipment in a refinery, the machine that gets the roughest use and abuse, the machine that runs until something lets go. I am referring to the much-abused duplex steam pump.

To start with the pump cold and follow through the pumping and shutdown, reveals at almost every turn a point at which the pump is abused. For example, lubrication is seldom thought of while starting; generally the operator starts the pump and then starts the lubricator, if he remembers to. Perhaps the pump has been standing two or three days. If such is the case, the chances are there is a thin film of rust in the cylinder. This is when the pump needs lubrication, at the first few strokes. Then again, consider the fact that the cylinders are full of water and cold. It is very easy to forget these all-important drains and start with them closed. But consider what might happen. When this water is left in the cylinder and expelled through the exhaust port, you are changing the temperature suddenly from around atmospheric to steam temperatures. One of the inherent weaknesses of a cast iron casting is its inability to withstand sudden temperature changes. You are taking a chance of breaking a cylinder casting. Again, starting in this condition (i. e., with drains closed and water in the cylinder), a sudden slamming on one stroke brings the steam piston up against the water in the cylinder; the water is incompressible and something has to give. Generally it is the cylinder head, and I have seen cases that resulted in additional damage to rods and liquid end castings.

After the pump is warmed up and started, if running with the suction valve closed, much damage can be done by a sudden opening of the suction valve. You would not run your automobile engine fast and suddenly snap in the clutch. The principle is the same in the pump. You are applying load by opening the suction valve. A sudden opening may mean dislodged valve seats or other serious complications.

Keep It Greased

Another common source of breakdown is that resulting from loss of suction. Especially in tank transfers, where one tank is being pumped out and is pumped dry, load is suddenly released from the pump and it runs away; before someone shuts it down, it may sustain numerous sprains, scratches, cuts and internal injuries. The same damage may be sustained by over-speeding the Duplex pump. It doesn't seem to be common knowledge but every Duplex pump has a definite rated speed over which it should not be run. The general practice seems to be to run them as fast as they will go. Speeding means over-stroking, which is payable in terms of new rods, new heads, and sometimes new pumps. This practice and the previous condition, i. e., loss of suction, accounts for more damage to Duplex pumps than anything else. If these could be eliminated, our pump repair costs would take a startling drop.

Another source of constant experiences is the question of piston rods. Perhaps the outstanding causes of piston rod wear are lack of lubrication, improper adjustment of glands and the use of packing unsuited to the service. In the packing of gasoline and other non-lubricating products, a swabbing of the rods with steam cylinder oils is to be recommended. In all Duplex pumps, lubrication of the steam rods should be taken care of by outside swabbing, not depending on the cylinder lubrication at all. You can make surprising savings on packing costs by doing this.

Mal-adjustment of the two-hole type stuffing box will score piston rods beyond repair in three or four strokes. Scored rods mean, in turn, loss by leaks and extra packing costs.

We could go on indefinitely and point out causes of repairs and replacements on the steam Duplex pump. Perhaps one per cent of the troubles can be blamed on the pump manufacturer; the rest of the sin is on our shoulders.

I have listed three points under which all of the above abuses can be classed:

1. Carelessness on the part of the operator.
2. Ignorance on the part of the operator.
3. Lack of proper lubrication.

Let us consider them in order:

Carelessness

A hundred panaceas can be offered to meet the common enemy to industry—carelessness. It takes toll in human life, health, happiness and dollars. It seems to me, however, that the one sure way to combat the evil is to work on the source—the man's interest in his job. A careless man is a disinterested man. Drastic measures such as dismissals and lay-offs have, in most cases, the desired effect, but arouse in some cases an antagonism that offsets results. I should suggest trying to arouse the man's interest. If he is not satisfied, transfer him, if possible, and place him where he is satisfied. Point out to him that how he meets his responsibility is the Company's measure of his success. Point out to him that the management is interetsed not only in results but in efficient results, and that efficient results are impossible with high maintenance-repair costs. Point out to him that it is his job to keep the equipment working efficiently and smoothly, just as it is your job to keep him working efficiently and smoothly. And last, but not least, if he is chronically careless and incurable, fire him, for nothing in a refinery is such a potential liability as a careless man.

Ignorance

Ignorance is much more easily combatted than carelessness. Ignorance can, however, be charged with a lot of the repair costs. Such points as knowledge of a rated speed, rated capacity, etc., can easily increase the life of a pump. Operators are essentially operators, and not mechanics. By a closer co-operation between the foremen of the operating and mechaincal departments, much can be done towards decreasing repair costs. For example: an operator may run a compressor excellently well and still not be able to recognize a loose crank bearing. In ignorance, he might run the compressor an hour, while waiting for a mechanic, and take the chance of seriously damaging the machine. If he was trained as he should be, when any strange noise developed, he would shut the compressor down immediately. Another example is well shown in the matter of packing. A mechanic knows how hard a gland should be pulled up to stop leakage. Beyond this point, new packing is needed. An operator might not know and pull up too hard, which results in scored rods or increased friction load. Again, ignorance as to the proper amount of lubrication would result in over-lubrication with its waste, or under-lubrication with its excessive wear.

Lubrication

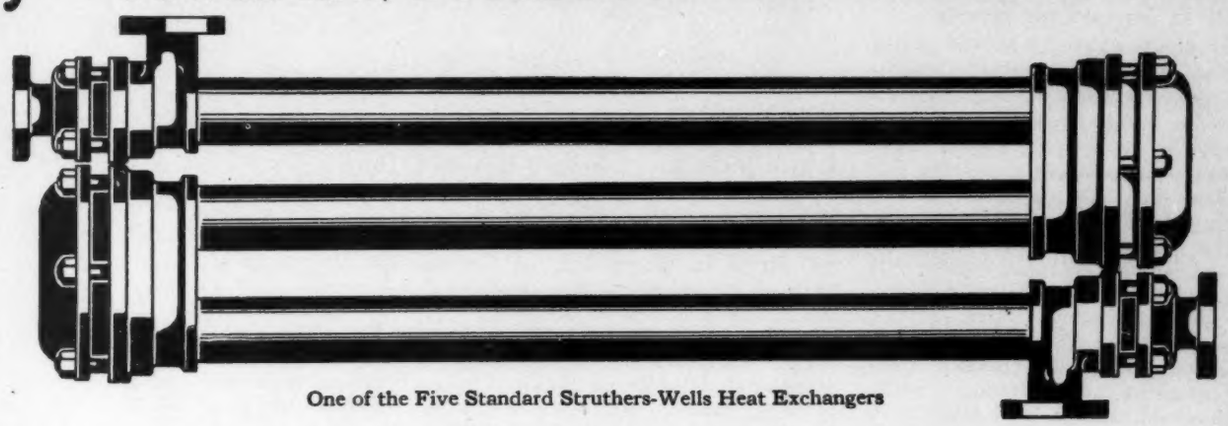
Lack of lubrication contributes much to our repair costs. It can be charged to either of the foregoing, i. e., Carelessness or ignorance. When you consider the part played by the lubrication and go into the details, it can be shown that, in power consumed alone, it is possible to effect a saving of from 10 per cent to 12 per cent. In considering the wear on the Duplex pump, remember that the average speed is about 60 strokes per minute. This means every part moves 120 times per minute. With no oil on the rocker arm stand, for example, it does not take long to wear a bearing beyond use.

I would like to diverge a moment here and stress the importance of this

STRUTHERS-WELLS

Standard Heat Exchangers

for OIL REFINERIES, CHEMICAL AND PROCESS WORKS
POWER AND BY-PRODUCT COKE PLANTS



One of the Five Standard Struthers-Wells Heat Exchangers

Incorporating the following Salient Advantages

1. The Highest Practical Heat Transfer Rate.
2. A High Fluid and Vapor Velocity.
3. Well Developed Turbulence.
4. A Very Low Friction Loss.
5. Removable Tube Bundle.
6. Easily Cleaned.
7. Full Allowance for Expansion and Contraction thus eliminating the usual shutdowns for re-rolling tubes.
8. A Special Type of Construction that positively eliminates interleaks and gasket leaks.
9. Small Space Requirements.
10. Standardized Construction.

Made in Five Standard Types to Suit all Conditions

This equipment is the perfected result of progressive improvement by this organization in the construction of over 5,000 heat exchangers of many types.

Progressive Executives and engineers will find in BULLETIN 10 an interesting description of this outstanding improvement in heat exchangers. Send for your copy today.

STRUTHERS-WELLS

Fractioning Towers	Mist Extractors
Shell Stills	Agitators
Fullers-Earth Burners	Heat Exchangers
Tube Stills	Condensers
Filters	Coolers

STRUTHERS-WELLS COMPANY

1020 Penn'a Avenue Warren, Pennsylvania

point on electric machinery. As you know, motors are generally high speed. There are only two bearings to oil and failure in either one of these bearings is bound to do electrical damage as well as mechanical damage. What happens is that the rotor drops down and drags on the stator, causing excessive heat and consequent damage to the winding. This is a concrete example of the far reaching effects of lack of lubrication.

Over-lubrication in a motor leaves an oil-covered surface where dust, grit and dirt collect, leaving a messy dirty scum on the end frame which, in time, is liable to get into the bearing.

Many points could be abused in the operation of centrifugal triplex and rotary pumps. Without going into minute detail, let us consider the major different in these two types. The centrifugal pump is not a positive displacement type and the discharge can be throttled and even closed with safety. The rotary pump is positive pressure and, if not equipped with relief valves, will build up a fracturing pressure with discharge valve closed. There two features should be given the closest attention by the operator. Generally speaking, the centrifugal pump is high speed, and lack of lubrication mean damage more extensive than bearing trouble, broken impellors and cracked casings often being the result.

The Operator's Creed

To genearlize, safety devices such as governors, relief valves and speed regulators for mechanical equipment, and fuses, overload relays and no-voltage devices for motors are being more and more extensively applied to the industry. However, the operator should always bear in mind that none of these devices are fool-proof, and become effective only with the co-operation, care and attention of the operator. Treat these devices with the respect due their station; never attempt to overload or speed up the equipment by manipulation of these devices because they are invariably set for safe operation.

In closing, I would be satisfied if I have succeeded in driving home this one point, namely, that upon the general attitude of the employee towards the equipment in his care, depends the life and usefulness of the machine. To ill treat and abuse this equipment, inevitably reflects on the operator directly. No more a potent and comprehensive sentiment on this subject can be found than this quoted below.

This is my job: To do towards the Company as I expect to be done by. To treat the equipment as if it were my own. To do my work in such a manner as to reflect only credit on my position. To be able to go home each night firm in the conviction that I have done a day's work to the very best of my ability, and firm in the knowledge that it is appreciated.

Big Eastern Oil Refineries Operate Mainly on Crude Petroleum from Other Industries

The Atlantic Coast States, which refine enormous quantities of petroleum, depend upon other domestic and foreign sources for 98.3 per cent of the crude oil put through their refineries, the United States Bureau of Mines, Department of Commerce, points out in a report just issued. Oil production in Western Pennsylvania and New York furnish 1.7 per cent of the crude oil refined in these States. Of the gasoline consumed, including exports, 47 per cent is refined outside of this group of States, while 47.2 per cent of the gas oil and fuel oil delivered in the region comes from outside refineries.

Total Atlantic Coast runs to stills of domestic and foreign crude oil in 1926 were 2,310,000 barrels larger than in 1925, states E. B. Swanson, economic analyst, in Information Circular 6050. This increase is a balance between a decrease of 3,253,000 barrels in the quantity of domestic crude oil refined and an increase of 5,563,000 barrels in the amount of foreign crude oil refined during 1926, as compared with 1925. Total Atlantic Coast receipts of domestic crude oil during 1926 were slightly larger than in 1925, being 103,056,000 barrels as compared with 102,798,000 barrels in 1925. The larger refinery runs of domestic crude oil in 1925 were due to the fact that 3,303,000 barrels were withdrawn from refinery storage during 1925 to augment the quantities received, while during 1926, 805,000 barrels were added to storage.

Shipments of crude oil by tankers from Gulf Coast ports increased from 72,556,000 barrels in 1925 to 78,992,000 barrels in 1926, while receipts by pipe line decreased from 16,246,000 barrels in 1925 to 12,069,000 barrels in 1926. The pipe line receipts in 1926 from the Appalachian and Illinois fields were approximately equal to those of 1925, but pipe line receipts from the Mid-Continent fields decreased from 11,903,000 barrels in 1925 to 7,458,000 barrels in 1926. Tanker receipts of crude oil from California were 2,000,000 barrels less than in 1925. Total receipts of foreign crude oils, including topped crudes and other fuel oils, increased from 50,763,000 barrels in 1925 to 52,492,000 barrels in 1926.

Production of gasoline by Atlantic Coast refineries advanced from 41,527,000 barrels in 1925 to 46,142,000 barrels in 1926, an increase of 4,615,000 barrels, or 11.1 per cent over 1925. This percentage increase in refinery production of gasoline corresponded with an average increase of 13.6 per cent in gasoline consumption in the Atlantic Coast area. The increased gasoline production was due partially to the fact that 2,277,000 more barrels of domestic and foreign crude oil were run through the refineries in 1926 than in 1925, but more largely to the fact that more gasoline was produced from the crude oil in 1926 than in 1925. The average recovery of gasoline per barrel of crude oil refined in 1925 was 32.4 per cent, or 13.6 gallons, which was increased during 1926 to 35.3 per cent, or 14.8 gallons. The greater recovery during 1926 was due to the increased output of gasoline by "cracking." The output of straight-run gasoline decreased from 61.1 per cent of the Atlantic Coast gasoline production during 1925 to 53.2 per cent in 1926, while the output of gasoline by "cracking" increased from 31.2 per cent in 1925 to 38.6 per cent in 1926. The use of natural-gas-gasoline accounted for 7.7 per cent of the 1925 output and 8.2 per cent of the 1926 output.

Production of gas and fuel oil at Atlantic Coast refineries during 1926 totaled 59,972,000 barrels, an increase of 1,047,000 barrels over the 1925 production. The refinery production of gas and fuel oil supplied 51.5 per cent of the total quantity distributed and was augmented by 23,627,000 barrels of topped crude and fuel oil received from foreign ports; 18,301,000 barrels received from Gulf Coast ports; 12,266,000 barrels received from Californit; 1,584,000 barrels shipped from Appalachian refineries; and 770,000 barrels of domestic crude oil which was burned directly as fuel, or a total quantity of 116,520,000 barrels available for distribution for commercial and industrial fuel purposes. Of the total quanity available, 111,531,000 barrels were marketed in Atlantic Coast States; 1,876,000 barrels shipped to foreign countries; 861,000 barrels shipped to States other than on the Atlantic seaboard; 1,027,000 barrels added to the quantity held in storage at refineries; leaving a balance of 1,226,000 barrels, which includes losses in handling and additions to quantities held in storage at other points than refineries.

The lowered price of fuel oil in California during 1926 affected the Atlantic Coast situation in two ways. First, the quantity received by Atlantic Coast distributors, including gas oil, increased from 1,298,000 barrels in 1925 to 12,226,000 barrels in 1926. The second influence would seem to be in the decreased amount delivered as bunker oil and to naval vessels. Deliveries of bunker oil at California points showed a considerable increase in 1926 over 1925, which would indicate that some vessels which had received bunker oil at Atlantic Coast ports during 1925 were bunkered at California ports during 1926. Such a change applied to oil tankers alone undoubtedly would be of sufficient magnitude to result in the decrease shown.

The increase shown in the consumption of gas and fuel oil by gas and electric power plants is accounted for almost entirely by the increases shown in the five South Atlantic States. The distribution in these States increased from 1,616,997 barrels in 1925 to 2,647,957 barrels in 1926, while, of the five States, Florida alone showed an increase from 1,106,653 barrels in 1925 to 1,830,543 barrels in 1926.

These Figures Speak Volumes

FOR WROUGHT IRON PIPE

THEY came right out of the files of a large eastern refinery and pay a big tribute to the rust-resisting properties of wrought iron. If wrought iron pipe shows up so well under normal conditions you can well imagine how it shows up to advantage under severe conditions. Reading Pipe fights off corrosion in alkaline soils, in marshy bogs, in river crossings and in salt water. In refinery pipe lines where sulphuric acid is encountered, Reading Hot-Dipped Amaloy coated pipe is recommended.

Reading Pipe is the only double-welded pipe for additional strength.

Comparative Annual Costs of Genuine Wrought Iron vs. Steel Pipe in Oil Refinery Pipe Line

Conditions

3960 ft. of 12-in., 50-lb. pipe laid 18" to 3' below the surface. Steel replaced after 10 years and wrought iron still in service after 20 years.

***Investment*—(Today's prices)**	***Steel***	***Wrought Iron***
Pipe	$12,700.00	$19,500.00
Fittings	2,300.00	2,300.00
Labor	10,000.00	10,000.00
Total	$25,000.00	$31,800.00
Annual fixed charges		
Depreciation:—		
Over 10-yr. life for steel	$2,500.00	
Over 20-yr. life for wrought iron		$1,590.00
*Average interest @ 6% —		
11/10 x $25,000.00 x .06/2	825.00	
21/20 x $31,800.00 x .06/2		1,001.70
Total per year	$3,325.00	$2,591.70
Annual saving		
Effected by use of wrought iron		$733.30
Percentage reduction in annual cost		**22%**

Note: The above is based upon a life of 20 years for wrought iron—the demonstrated life to date—but far exceeded by the actual life of many pipe lines at this plant.

* *Allowing for interest earned by depreciation reserve*

Reading's Identification

For identification we knurl our spiral trade mark upon every length of Reading Genuine Wrought Iron Pipe. Neither paint nor time will erase this permanent identification mark which protects you against error or substitution.

READING PIPE

GENUINE WROUGHT IRON

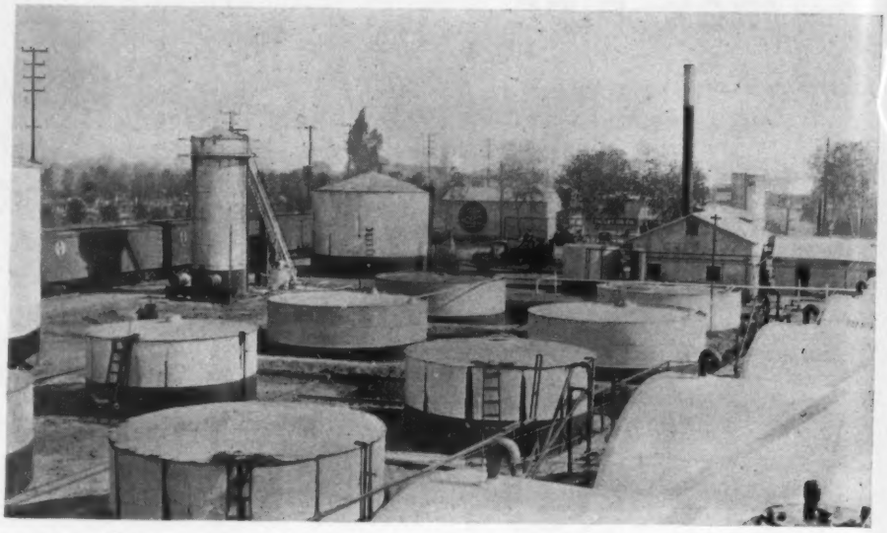
READING IRON COMPANY HOUSTON, TULSA, FT. WORTH SAN FRANCISCO, LOS ANGELES READING, PENNSYLVANIA

Mention Where You Saw the Advertisement

Only Refinery In Arizona Supplies Local Demand

ALTHOUGH the Rio Grande Oil Company's refinery at Phoenix, Arizona, is a small installation and therefore of no great economic importance, there are some items of interest found in connection with the operation of the plant. The refinery or skimming plant, is the only installation for the distillation of petroleum in the entire State of Arizona. Formerly there were two refineries in that State, but the other plant has been dismantled and converted into a bulk distributing station. The Rio Grande plant, though small, is complete in every detail and has been in profitable operation for several years.

Facilities are provided for distillation and fractionation of crude petroleum, as well as the necessary equipment for chemical treatment of the finished product. All of the crude supply for the plant is received by tank car from the Sante Fe Springs Oil Field in California and from the light or high gravity crude from Gallup, New Mexico, which for the most part is derived from the Rattlesnake field. This latter oil is interesting in its composition. The color is that of a mixture of gasoline and a small percentage of light lemon colored lubricating oil,—giving the crude a transparent pale lemon color which upon distillation yields around 75 per cent gasoline and occasionally more. The gravity of the crude oil runs around 65 to 70 degrees A. P. I. At the time of the writer's visit the still was charged with this oil and at a temperature of about 130 degrees Fahrenheit there was difficulty in accomodating the stream of distilled light gasoline. The refinery usually operates on about equal proportions of New Mexico and California crude charging to the plant around 15,000 barrels of oil monthly.



GENERAL VIEW OF THE PHOENIX, ARIZ., RIO GRANDE OIL COMPANY REFINERY SHOWING STEEL STORAGE AND RUN DOWN TANKS, BOILER HOUSE, PUMP HOUSE AND AGITATOR EQUIPMENT

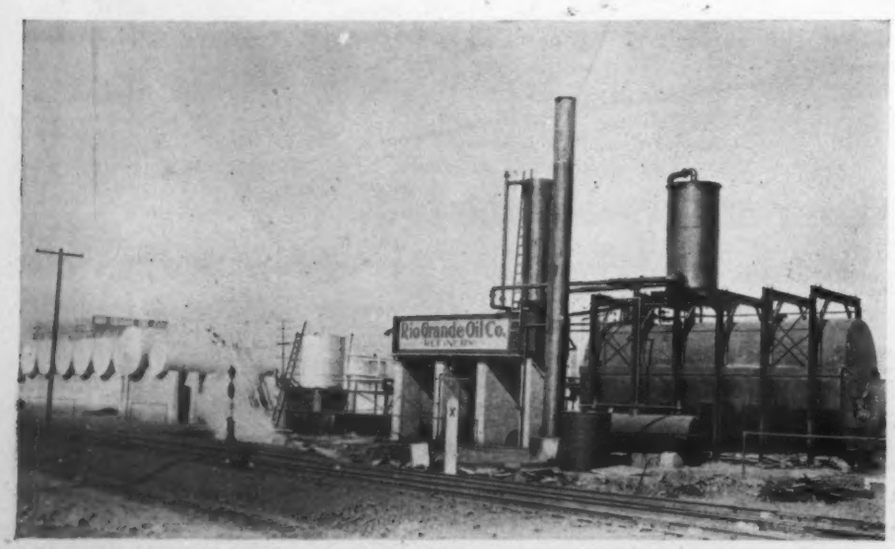
The distillation unit consists of one 10 feet by 40 feet shell still, well insulated and supported upon its setting by six structural steel frames, in the manner illustrated in Figure No. 1.

The still is charged and batched down after the usual manner in batch still systems. The vapors distilled from the oil are conducted through two towers of the baffle plate type, then through continuous coils submerged in water in the the condenser box as shown in Figure 1.

The pumps used for transferring finished product about the plant, loading oils, and unloading crude, as well as the pump charging crude to the still etc., are all Worthington 6x4x6 inches. One Ames horizontal return tubular boiler supplies steam for the operation of the plant.

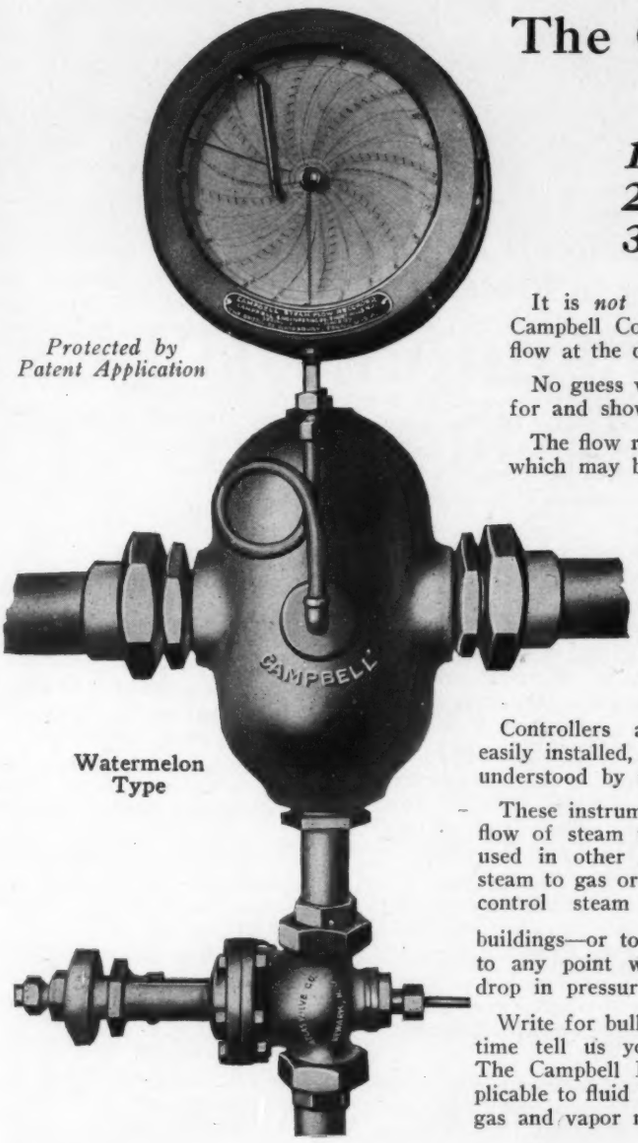
One 500-barrel agitator is sufficient for the treating of both the gasoline and kerosene produced by the plant. In this connection the men in charge of operations have estimated their agitator charging to a nicety and simplified their work somewhat. The still is permitted to produce gasoline in one tank up to a certain predetermined level, which in this instance is six feet and two inches. The water is drained from the tanks, keeping them free of water, or below the pumping out level. When the gasoline has reached the gage level desired in the tank, the still is cut into the other run down tank, and the first tank full charged to the agitator. The gage level is just sufficient to charge the agitator for treating. In the process of chemical treating the company used sulphuric acid in small amounts, followed by caustic neutralization and then following with a small amount of clay. All of the work is done in the agitator.

Since the company is operating the only oil refinery in the state, they have as their immediate territory to supply the immediate neighborhood of Phoenix and the outlying towns that are within reach of their distributing trucks, one of which is shown loading up in the second illustration. Many of the local industrial enterprises consume fuel oil in their power plants, being assured of a constant supply by the nearness of the Rio Grande's Phoenix skimming plant.



VIEW OF DISTILLATION UNIT OF THE ONLY REFINERY IN THE STATE OF ARIZONA, AT PHOENIX. RIO GRANDE OIL COMPANY SKIMMING PLANT

Steam to Oil Stills
regulated in a practical way



Protected by Patent Application

Watermelon Type

The Campbell Steam Flow Controller

1. Controls steam flow;
2. Records steam flow;
3. Gives direct reading.

It is *not* an ordinary meter. A meter records only. The Campbell Controller controls, records, and indicates the steam flow at the desired rate.

No guess work. It maintains a flow rate at the point it is set for and shows that rate.

The flow rate is given in pounds of steam delivered per hour, which may be varied as the operator desires.

A worth while saving is effected in steam, condensing water, fuel and labor.

There are two types as shown in these illustrations.

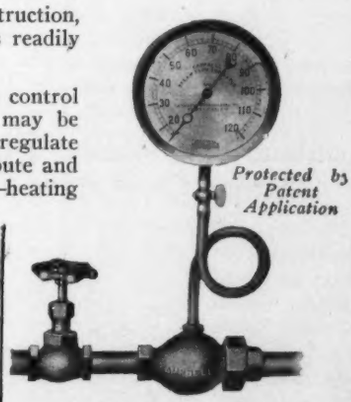
The Campbell Steam Flow Recorder is uniform and interchangeable for all service conditions.

Correct rates of flow are quickly produced at the will of the operator.

Controllers are rugged in construction, easily installed, and the adjustment is readily understood by the operators.

These instruments were designed to control flow of steam to oil stills, but they may be used in other process work or to regulate steam to gas or oil burners—to distribute and control steam for drying work—heating buildings—or to regulate steam flow to any point where an appreciable drop in pressure may be allowed.

Write for bulletin and at the same time tell us your steam problems. The Campbell Flow Control is applicable to fluid level problems, traps, gas and vapor reliefs, etc.



Protected by Patent Application

Pumpkin Seed Type

FILL IN, TEAR OFF AND MAIL

The Campbell Engineering Co., Short Hills, N. J.

Manufacturers of the Tar Baby Burner, to handle Fuel Oils, Water Gas Tar, Acid Sludge, and Residue Fuels.

Without obligating us in any way, please send information on ( ) the Watermelon Type, ( ) the Pumpkin Seed Type, ( ) the Tar Baby Oil Burner. Our problems are approximately as written below:

Our Problems .....
.....
.....
.....
.....

Name.....
Firm.....
Address.....
.....
.....

Refinery and Gasoline Plant Activities

Wichita Falls Men To Build Plant Near Pyote

Wichita Falls, Texas.—The Valley Refining Company has been organized by Eugene F. Griswold and associates of Wichita Falls, to erect a 2500-barrel daily capacity skimming plant in the West Texas district, to operate on Hendrick field 29-30 gravity crude. The plant site is on the T. & P. Railroad near the town of Pyote, and adjacent to tank farm and crude oil tank car rack owned by Texon Oil & Land Company. The latter concern has contracted to deliver 2500 barrels of crude daily over the balance of 1928 to the Valley Refining Company at a flat price of 65 cents per barrel f. o. b. plant. This price figures only five cents per barrel above the posted price now applying to crude purchased in the field proper, and Texon delivers the oil via an 18½-mile, six-inch line.

The Valley Refining Company has contracted for the sale of 60 cars of fuel oil monthly over balance of the year to a Chicago concern, at a flat price of 45 cents per barrel, f. o. b. buyer's cars. This price figures about 70 cents per barrel, Group Three territory, considering the difference in freight rates to Chicago territory. A fleet of auto trucks is to be put in service by the Valley Refining Company to market a large portion of its gasoline within a driving radius of Pyote.

Louisiana Gasoline Plant Starts Operation

Shreveport, La.—Handling about 20,000,000 feet of gas a day, from which it extracts 8000 gallons of gasoline, the Natural Gas & Fuel Corporation of El Dorado, Arkansas, is now operating its new $100,000 absorption plant at Magenta, Louisiana, with George T. Koch, chief engineer of the corporation, in charge. The gas which goes through the plant comes from the Richland and Monroe gas fields, and after passing through the plant is sent on to El Dorado through a 10-inch line leased from the Continental Supply Company. Most of the gas of the line is the production of the corporation that owns the new absorption plant.

New Refinery Operating

Dallas, Texas.—The Bluebonnet Oil & Refining Company began operating its 3500-barrel daily capacity skimming plant at Wickett, Texas, early in January, and was running near capacity by the middle of the month, according to John T. Withers, Jr., president. This plant is located in West Texas on the Texas & Pacific Railroad, and is supplied with crude on contract by the Southern Pipe Line Company, which has a line extending from the Hendrick field, Winkler County, to Wickett, where Southern has a tank farm and large tank car rack. J. B. Chittenden is in charge of the above plant, which is limiting its production at present to fuel oil and tops. The fuel oil is sold on contract to the T. & P. Railroad, and the tops are being sold to other refineries. Headquarters of the Bluebonnet Oil & Refining Company are located at 1009 Santa Fe Building, Dallas.

Texas-California Pet.'s Merger in Process

New York.—Merger of The Texas Corporation and the California Petroleum Corporation has been arranged on condition that at least 51 per cent of the latter's stockholders enter into the agreement. The final plan calls for the exchange of one share of Texas Corporation stock for two shares of the California Company.

Merger of the two companies gives The Texas Corporation a good foothold in California.

The California Petroleum Corporation is one of the strongest independents on the Pacific Coast, and has large marketing and refining facilities. The company also owns valuable concessions in Mexico and Venezuela.

The two companies have an authorized capitalization of $375,000,000. The Texas Corporation owns practically all the stock of the former The Texas Company.

Properties of The Texas Corporation total approximately 2,400,000 acres, with pipe line systems, storage and refining facilities among the largest in the world.

The Texas Corporation has no funded debt. Its authorized capital stock amounts to $250,000,000, of which $181,060,000 is outstanding.

The California Corporation has authorized $125,000,000 capital stock ($25 par), of which nearly $50,000,000 is outstanding. The funded debt of this company is less than $20,000,000.

Process Construction Company, a California corporation which was organized for the purpose of constructing a cracking plant for the treating of oils and other products, has received a permit from the state corporation commissioner to issue stock, and has signed a contract with the Gasoline Process Company, for whom the cracking plant is to be built. According to its application, the Process Construction Company is a subsidiary of the Western Oil & Refining Company. Its officers include Richard Florian, L. J. Hart, A. A. G. Scherbel, A. W. Taylor and Arthur G. Baker.

Roxana Corporation Buys Tract at Houston

Houston.—Roxana Petroleum Corporation has purchased 600 acres of land along the ship channel near here, and it is rumored that the property will be used as a site for a new refinery. Officials of the company, however, have announced that they have "no present plans for its use." The land is suitable for a refinery or a crude oil terminal.

It is a short distance down the channel from the refining plants of Keen & Woolf, Galena-Signal Oil Company, and Sinclair Refining Company.

It is reported that Shell Pipe Line Company is running a survey for a trunk line from McCamey in West Texas to Roxana's refinery site near Houston. Such a line would require about 450 miles.

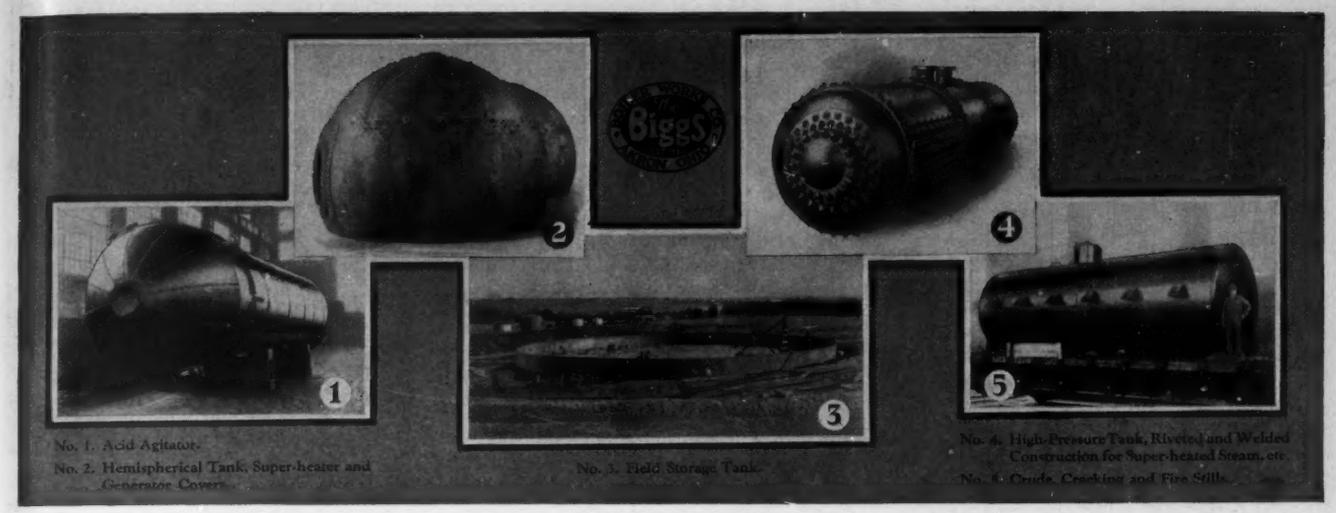
New Phillips West Texas Plant Starts March 1

All construction work of the Phillips Petroleum Company's newest natural gasoline plant in the Texas Panhandle is expected to be completed by March 1. Location of the plant is eight miles southeast of Pampa, in the Bowers field of Gray County, being in the southwest quarter of section 88. The capacity of the plant will be 15,000 gallons a day. The company has obtained permission from the State railroad commission to sell 25,000,000 feet of residue gas daily from the new plant to carbon black companies active in the district.

J. M. Wadsworth, who has been manager of the Okmulgee, Oklahoma, refinery of the Independent Oil & Gas Company, now has his headquarters in the General offices of the company at Tulsa, having been placed in general charge of the refinery operations of the concern. In addition to his duties with the refining department, including supervision of sales, traffic and plant operations, he will also be in charge of the Oklahoma pipe line operations of the company.

The tank car sales of the company will continue to be handled by J. V. McCormick, sales manager; and S. B. Myers is traffic manager of the refinery division.

The new manager of the Okmulgee refinery, succeeding Mr. Wadsworth, is R. D. Evans, who was formerly assistant superintendent of the plant. E. W. Potter, formerly general foreman of stills, has been made assistant superintendent; and his position as foreman has, in turn, been filled by Russel Dunbar.



No. 1. Acid Agitator.
No. 2. Hemispherical Tank, Super-heater and Generator Covers.
No. 3. Field Storage Tank.
No. 4. High-Pressure Tank, Riveted and Welded Construction for Super-heated Steam, etc.
No. 5. Crude, Cracking and Fire Stills.

Steel Plate Equipment that Satisfies Every Oil Field Requirement

THE man or firm that buys tanks, stills, agitators or other producing and refining equipment can't afford to gamble on his source of supply. A few minutes delay and waste effort may cost big money.

Biggs knows oil industry problems. Throughout the life of the industry this organization has been designing, accurately fabricating and erecting steel plate equipment for use under severe operating conditions.

In personnel, resources and manufacturing facilities, Biggs is today better equipped than ever before in its 40 year history to produce both standard and special jobs promptly and economically.

You can depend on Biggs heavy steel plate work. We'll be glad to help you solve your equipment problems.

Manufacturers of

- Pressure Stills for Cracking Process
- Fractionating Towers
- Dephlegmating Towers
- Bubble Towers
- Heat Exchangers
- Agitators
- Steam Stills
- Crude Stills
- Condenser Boxes
- Run Down Tanks
- Blending Tanks
- Hemispherical Tanks
- Blow Cases
- Acid Tanks
- Compounding Kettles
- Storage Tanks to 80,000 Barrels
- Smoke Stacks and Breechings, etc.

THE BIGGS BOILER WORKS COMPANY

General Offices and Works: Akron, Ohio
Eastern Sales Office: 300 Madison Ave., New York City
Chicago Office: 35 South Dearborn Street

Now is the right time to mail this coupon

THE BIGGS BOILER WORKS COMPANY
Akron Ohio

Please send us, without obligation, a copy of "What Biggs Does, and How." We are interested in the following equipment.....

Please see us on or about .....

.....

Firm .....

Individual .....

Address .....

The Biggs Boiler Works Co. Akron Ohio Est. 1887 — Trade Mark Registered

TANKS AND GENERAL STEEL PLATE WORK *for the Oil Industry*

Mention Where You Saw the Advertisement

SAGINAW PLANT STARTS

Saginaw, Mich.—The new refinery which has been built near here by the Standard Oil Company of Indiana is now in operation, the daily runs amounting to about 800 barrels. The plant has a capacity, however, of 2000 barrels. The crude oil for the plant is coming from the newly developed Saginaw field.

SUNBURST REFINERY RESUMES

Great Falls, Montana.—The California Petroleum Corporation expects to have its Sunburst, Montana, refinery in operation by January 15, after spending $200,000 for the installation of new equipment. This plant was purchased from O'Neil Brothers. The installation of equipment will consist chiefly of replacing the stills of the plant by a series of Foster tube stills, which are used in all other California Petroleum Corporation refineries. The former capacity of 17,000 barrels a day will not be increased.

ST. HELENS BUYS PLANT

Making its first venture in the refining industry, the St. Helens Petroleum, one of the older producing companies of California, has purchased the Montebello refinery of the Golden West Petroleum Corporation, and has re-equipped it as a straight-run plant, the daily runs now being about 1000 barrels. The gasoline being produced is marketed through independent service stations under the trade name of "Blue Ribbon."

MAKING ANTI-KNOCK GASOLINE

Beaver Refining Company, operating cracking units of the Leamon vapor phase type on the plant site of the Maple Leaf Refining Company, Chatham, Ontario, has these units in operation producing "Stellarine"—which is the trade name for anti-knock gasoline derived through the operation of the vapor phase cracking plants. The gasoline is being distributed at Canadian points by the Maple Leaf Refining Company.

HOUSTON PLANT CLOSED

Houston.—The Keen & Woolf refinery located on the Ship Channel, has been shut down for an indefinite period. It is the second refinery of this district to be shut down within the past few months, that of the Galena-Signal Oil Company of Texas having been previously closed. The Keen & Woolf plant is a lubricating oil refinery of about 2000 barrels capacity daily.

Chiefly for the purpose of selling asphalt and road oils, the New Orleans Refining Company, Ltd., has opened an office at 624 South Michigan Avenue, Chicago.

SCHULZ PROCESS IN JAPAN

Chicago. — F. L. McWatty, New York representative of the Asano Bussan Company, a Tokio, Japan, concern, was here recently conferring with officials of the Red River Refining Company, owners of the Schulz Vacuum Process. Stills of this design were installed by the two leading refining companies of Japan, in accordance with contracts which the Asano Bussan Company induced them to make.

MAKING SPECIALTIES

Augusta, Kansas.—Several new products, including cleaning fluids, incubator fuel, rubber solvent and cigar lighter fluid, will be placed on the market about April 1 by the White Eagle Oil & Refining Company, following completion of a specialty plant for their manufacture in the refinery of the company here.

SEMINOLE PLANT STARTS

Tulsa.—The new 15,000-gallon gasoline plant of Forrest E. Gilmore & Company in the Little River pool of the Seminole area, which has started operating, is run in conjunction with the same company's three plants at Bowlegs, the stabilizing, storing and loading for all plants being at the Company's No. 7 Bowlegs plant. The new plant contains eight 165-horsepower engines and operates as a compression type.

WEST INDIES REFINERY

Proposing to refine crude oil from Venezuela or other places and to deal in the refined products, the Eagle Petroleum Company (Arend Petroleum Maatschappi) is building a refinery at Aruba, an island off the Venezuelan Coast which is a part of the Dutch colony of Curacao, Dutch West Indies. The Eagle Petroleum Company was incorporated at Willemstad, Curacao, last October.

BERGIUS PROCESS IN CHILE

The Bergius process for the manufacture of synthetic gasoline from lignite coal is being used in Chile, South America. Two large plants have been erected near Santiago, Chile, according to the Chilean consul at Hamburg, Germany. Reports are also at hand stating that the German Dye Trust, principal owner of the Bergius patents and process, has developed an improved oil refining process in which high pressures are employed in the treatment of heavy oils.

BUILD SKIMMING PLANT

Houston—The skimming plant of the Valley View Refining Company of Wichita, Kansas, being built near Manahans, Ward County, Texas, is due to be in operation within a short time. Its capacity will be 2500 barrels a day. Winkler County Crude will be piped to the plant through a six-inch line by the Texon Oil & Land Company.

NAME NEW OFFICERS

Officers recently elected by the California Natural Gasoline Association include the following: H. L. Eggleston of the Pan-American Petroleum Company, vice-president; H. R. Linhoff of the Richfield Oil Company, and John N. Hicks, members of the executive committee; and E. L. Tobias of the Bankline Oil Company, and W. P. Smith of the Wilshire Oil Company, members of the board of directors.

ADD ABSORPTION PLANT

Increasing its already large natural gasoline output in the Texas Panhandle, the Phillips Petroleum Company will build an absorption plant at Sanford, Hutchinson County. The initial capacity of the plant will be 2,000,000 feet of gas daily, and the gasoline yield of that amount will be about 2000 gallons. The gas for the plant will come from wells in the west extension of Hutchinson County.

START GILLIAM, LA., PLANT

The Texas Company started operating its new Southwestern gasoline plant at Gillam, Louisiana, early in December. The plant has a capacity of 7500 gallons daily. Texas Company's Wynona, Oklahoma, plant, which is also a Southwestern 75, was placed in operation during the latter part of December.

OPERATING CROSS UNIT

Tulsa.—With gas oil as charging stock, a new Cross cracking unit has been put in operation by the Barnsdall Refineries, Inc., at its Okmulgee refinery. Most of the latest developments in the design of the Cross process are incorporated in the unit.

A natural gasoline plant of the oil absorption type has been put in operation at Wichita, Kansas, by the Empire Gasoline Company. Gas for the plant is taken from the main gas line of the Cities Service Gas Company.

HEADS MONTANA DIVISION

M. C. Henderson, vice-president of the Sunburst Refining Company, Great Falls, Montana, is now president of the Montana division of the Rocky Mountain Oil & Gas Association, having been elected at the annual meeting of the association held here recently. Mr. Henderson manages the Great Falls refinery of the Sunburst Refining Company, and also has charge of the company's marketing.

HALEY TO HAVANA

W. J. Haley, who has been manager of the Charleston, South Carolina, refinery of the Standard Oil Company of New Jersey, has been transferred to Havana, Cuba, to take charge of the company's plant there; and J. E. Lenhardt has been selected as his successor as manager of the Charleston plant.

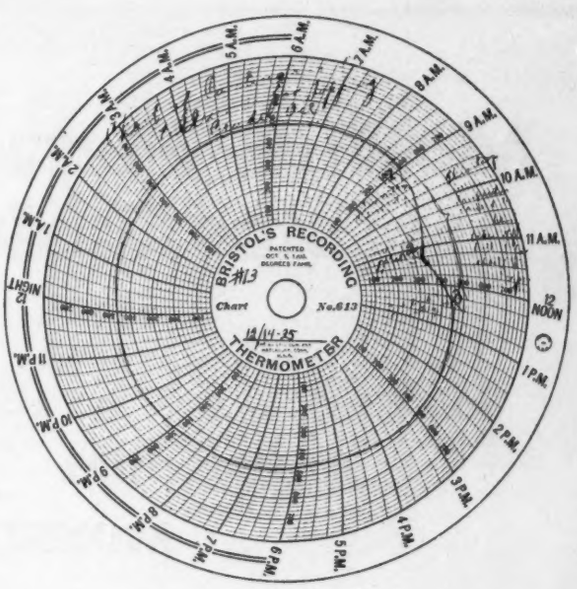
A Continuous Check On Oil Still Operation

NOTE how closely the exact time and extent of unusual operating conditions can be checked-up on the chart record above—for example the marked temperature fluctuation showing from around 9 A. M. to 12:30 P. M.

This was caused by the still being cut off the battery during repairs on tower. At (1) still was cut off; (2) fire was applied, and temperatures gradually increased until still was again cut back on battery at (3),

Bristol's Recording Thermomcter, with round chart and moisture proof casc.

Such records are especially valuable to the management, as they give a concise outline of the operating conditions in each unit, or process, during the entire day.



Full Day's temperature record of continuous oil still used for topping crude oil.

The simplicity of Bristol's Recording Thermometers assures accurate, trouble-free service. Sturdily constructed they "stand the gaff" year after year, and at a maintenance cost which is remarkably low.

Have Bristol's Sales Engineers make a survey of instrument needs in your plant. No obligation.

BRANCH OFFICES
Boston
New York
Philadelphia
Pittsburgh
Birmingham

The Bristol Company
Waterbury, Connecticut

BRANCH OFFICES
Detroit
Chicago
St. Louis
Denver
San Francisco

National Association Meeting

The semi-annual meeting of the National Petroleum Association will be held this year at the Hotel Riverside, Cambridge Spring, Pennsylvania, on April 19 and 20. The association trustees began their preparations for this meeting at the October meeting of the board, and the program committee promises a program that will be interesting and of great practical value, at this two-day session.

The Lone Star Gas Company plans to build a 10-unit natural gasoline plant on the M. & A. Blackwell farm, eight miles northwest of Desdemona, Texas. This will be the first plant in the new pool.

West Texas Plant

Dallas, Texas.—The Superior Refineries, Inc., has been organized by Harry A. Wier, J. B. Hamer and J. O. Pratt, with a capital stock of $16,000, to erect a small refinery in West Texas as soon as an adequate crude supply can be had. Headquarters are maintained at 505 Melba Building, Dallas. Odessa has been tentatively selected as a location for the plant.

Dixon Creek Oil Company is rebuilding its gasoline plant near Borger, Texas, which was destroyed by fire some time ago. The new plant under construction is a Southwestern unit of 18,000 gallons capacity, and is expected to begin operation about the middle of January.

McKim Metallic Asbestos Gaskets

COPPER

ALUMINUM

MONEL

ARMCO

Plain or Corrugated

Catalog No. 17 on Request

McCord Radiator & Mfg. Co.

Manufactures of McCord Force Feed Lubricators

DETROIT, MICH.

California—Chandler & Warden, 121 West Pico St., Los Angeles

Natural Gasoline Men to Meet in Tulsa

Tulsa—The next annual meeting of the Natural Gasoline Association of America will be held in Tulsa during the three days beginning May 22, according to A. V. Bourque, secretary of the association.

Dr. G. G. Brown of the University of Michigan, who has done research work for the association for two years, will be one of the principal speakers. A trip to the Seminole field will be another feature of the program.

Steam Leaks and How To Stop Them

(Continued from page 75)

nut put back. This method is used for restricted quarters. Where the leak is localized and more room to work exists, the dam can be made of a strip of metal.

In all cases the equipment is easily and quickly attached and the sealing compound is effectively forced into the opening to stop the leak.

Recently, the compound has been applied to sealing the bolted joints in new and old turbine casings, condensers, and in the low-pressure connections between turbines and condensers. Leaking out of steam and entrance of air into low-pressure regions are thereby eliminated. In one case where a large unit was sealed with the compound the vacuum was said to have been increased 0.6 inches of mercury, reducing the water rate of the turbine 4.2 per cent.

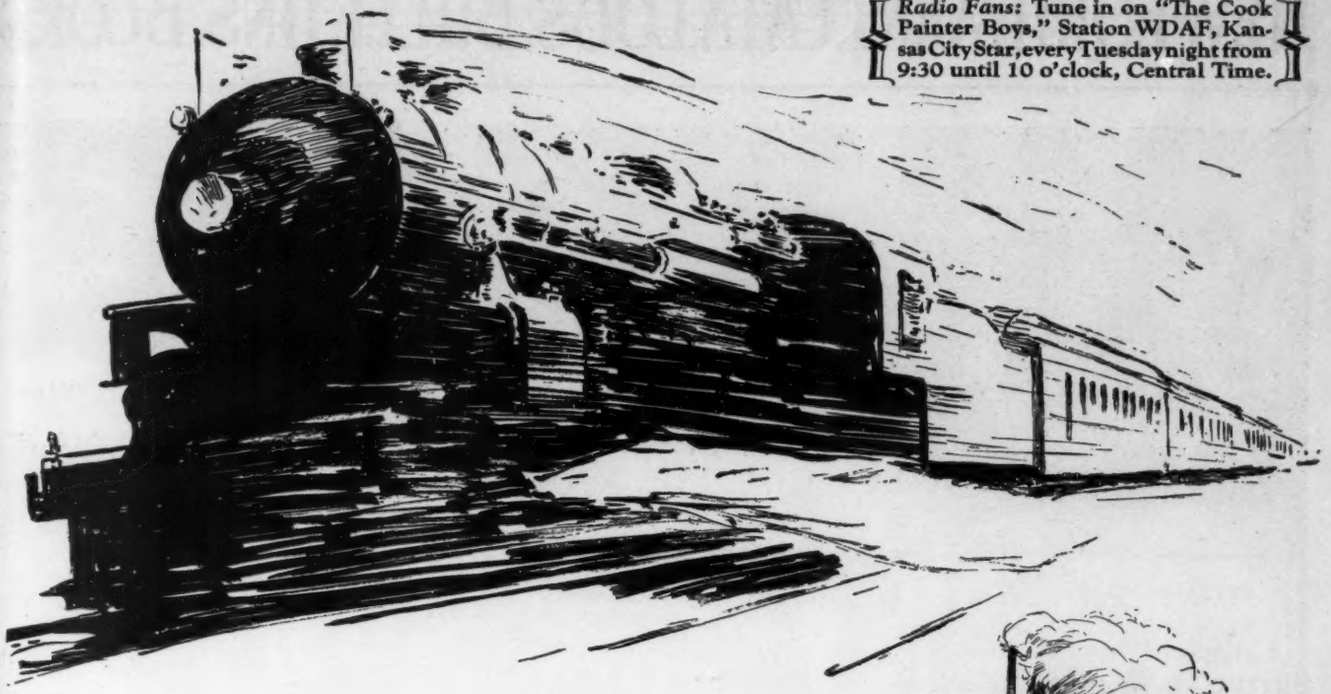
Care of Open Drips

A prolific source of steam leaks in oil refineries are open drips, the remedy for which is the use of efficient traps. It is true that even the best traps may leak at times and, therefore, in order that such leaks may be readily detected the discharge should never be run to blind drains or sewers; instead the drips should discharge into catch basins or other receptacles where the discharge pipe is visible. For, if the latter suggestion is not practiced, it is impossible to tell when some trap may have developed a leak of considerable financial importance.

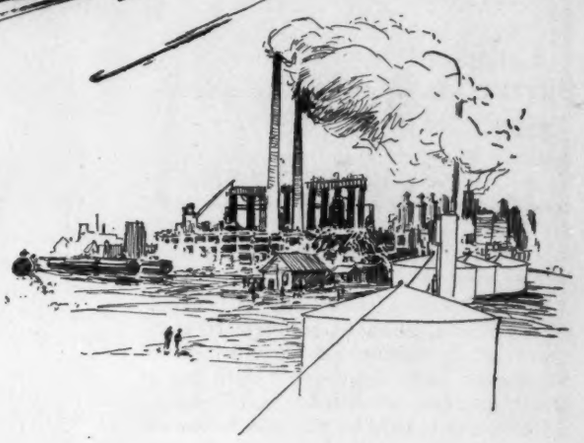
Although the foregoing discussion has applied almost exclusively to the matter of steam leaks, attention is also called to the fact that both air and water are too costly to waste; for just as much power is required in the compressor and in the pump to furnish the amount lost as for an equivalent amount applied to useful purposes. All leaks in oil refineries, whether steam, air, gas, water or oil, should receive prompt attention if operating costs are to be kept at a minimum.

E. J. Mary, until recently refinery superintendent for Shreveport Producing and Refining Company at their Jewella, Louisiana, plant, is now in charge of refinery operations for the Chalmette Petroleum Company, New Orleans, Louisiana.

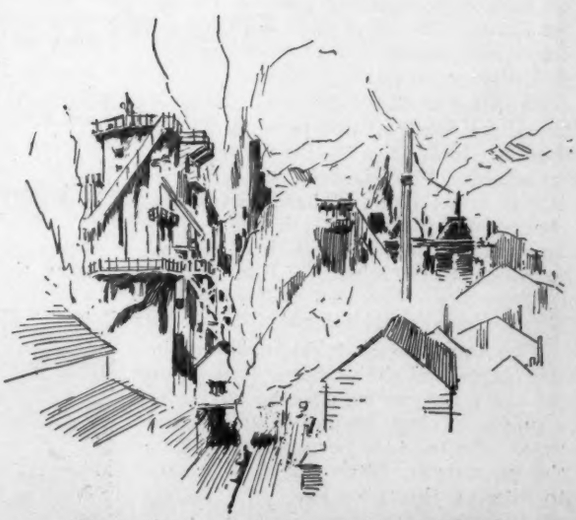
Radio Fans: **Tune in on "The Cook Painter Boys," Station WDAF, Kansas City Star, every Tuesday night from 9:30 until 10 o'clock, Central Time.**



When You Want Paint, You Want It *Right Now!*



And Cook's, with five factories and ten branches located in the heart of the mid-continent oil fields, are able to give you *"right now" service!* Whether you need some of the famous paints we have perfected for the oil industry and carry always in stock—or whether you desire a special formula made to order on a moment's notice—Cook's have the equipment and the trained specialists to give you what you require, *pronto!* Just ask our nearest factory or branch!—COOK PAINT & VARNISH COMPANY.



COOK FACTORIES:

Kansas City Fort Worth Houston
St. Louis Cincinnati

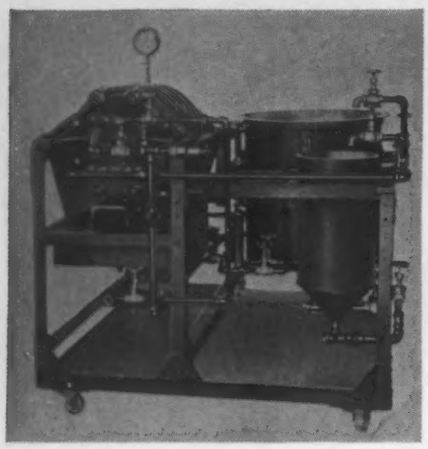
COOK BRANCHES:

Tulsa Oklahoma City Wichita Dallas
Omaha Denver Kansas City, Kansas
St. Joseph, Missouri Chicago Detroit

SPECIALIZED PAINTS FOR THE OIL INDUSTRY

Mention Where You Saw the Advertisement

NEW EQUIPMENT, CATALOGS, BULLETINS, BOOKS



KELLY PRESSURE FILTER

Lubricating Oil Filter

UNITED FILTERS CORPORATION

The United Filters Corporation, Hazelton, Pennsylvania, announce the Type O-R Kelly Pressure Filter for reconditioning Diesel and other crankcase oil. The outfit is especially recommended for Diesel installations in pipe line service.

Reconditioning spent oils by means of the filter is about as follows: Heated spent oil is merely passed through a filter cake built up on the cloth by a small amount of filter aid. Foreign solid matter is held by the cake, cleaned oil passes through and goes into service again. The filter cake with its accumulated carbons is then discharged and thrown away.

The shell of the outfit is of cast iron, tested for working pressures up to 200 pounds. Inside the shell are a series of rectangular filter leaves, covered with Monel metal cloth. These leaves discharge the filtered oil through pipes into a single outlet manifold. The head to which are attached the filter leaves, is stationary. The shell slides back to permit discharging the cake.

Two cone bottom tanks make up the storage part of the unit, one tank being for the spent oil supply, the other for a supply of clean oil and filter-aid mixture. The mixture is used to make up the pre-coat or filter cake preliminary to filtering the spent oil.

In the dirty oil tank is placed a heating coil through which steam or hot water may be passed. Heating is usually necessary to give the dirty oil a higher filtration rate. Also in this tank is a line to supply air for agitating the dirty oil and filter aid so as to insure a good mixture. Where necessary, other means of agitation can be provided.

Capacity of the tank is sufficient to hold one full charge of dirty oil plus the drainings from the previous run. The pre-coating tank is much smaller, being only large enough to hold a supply sufficient to fill the filter shell and have a little left over for circulation.

Directly under the filter leaves is a small removable pan into which the cake is scraped from the leaves and which also receives the drippings that occur when the shell is opened. It is large enough to hold the cake from a dozen more runs so only intermittent cleaning of the pan is necessary.

The pump is fitted out on the liquid end with a bronze piston with cast iron rings to withstand any abrasive action from the dirty oil. The air pump operates on a 5 to 1 ratio so that filter pressure up to 200 pounds can be had from an air supply rated at 40 pounds.

All these parts are assembled into a single unit, supported by an all-metal frame resting on casters so that the unit can be easily moved about.

Further information can be obtained by writing the company and asking for bulletin No. 121.

Edison Safety Lamp

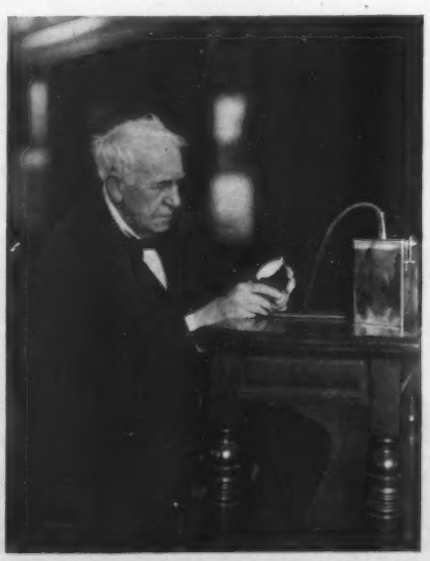
MINE SAFETY APPLIANCE COMPANY

The Mine Safety Appliance Company, Pittsburgh, Pennsylvania, announces a new improved Edison Safety Cap Lamp, known as Model G.

The new lamp is approved by the United States Bureau of Mines for use in gassy atmosphere and is especially suitable for use in various refining operations where dangerous gases and vapors may be involved.

Among the features of the lamp is a light-weight and rugged Bakelite headpiece. A two filament gas filled bulb furnishes 17 candle power through the use of the major filament and five candle power through the use of the minor filament.

More particulars can be obtained by writing the company, direct.



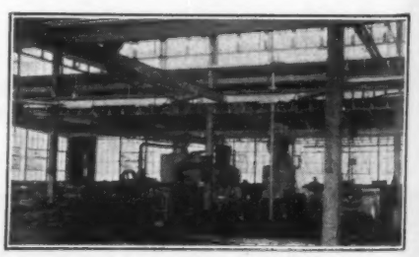
EDISON AND THE NEW SAFETY LAMP

TWO OF THE ELECTRIC FURNACES

Metric Metal Works Enlarges Its Plant

Erie, Pa.—In order to meet the increased demand for Metric Meters, the Metric Metal Works with headquarters in this city, has recently found it necessary to provide additional machine shop space for the fabrication of its products. It was decided that this could best be accomplished by converting the foundry building adjoining the main factory into additional machine shop room and building a new foundry.

The new foundry is located across from the main plant and is connected with it by means of a subway. The Building, of brick and steel construc-



CLOSE-UP OF OVERHEAD TRACKS SHOWING SWITCHES AND CURVES.

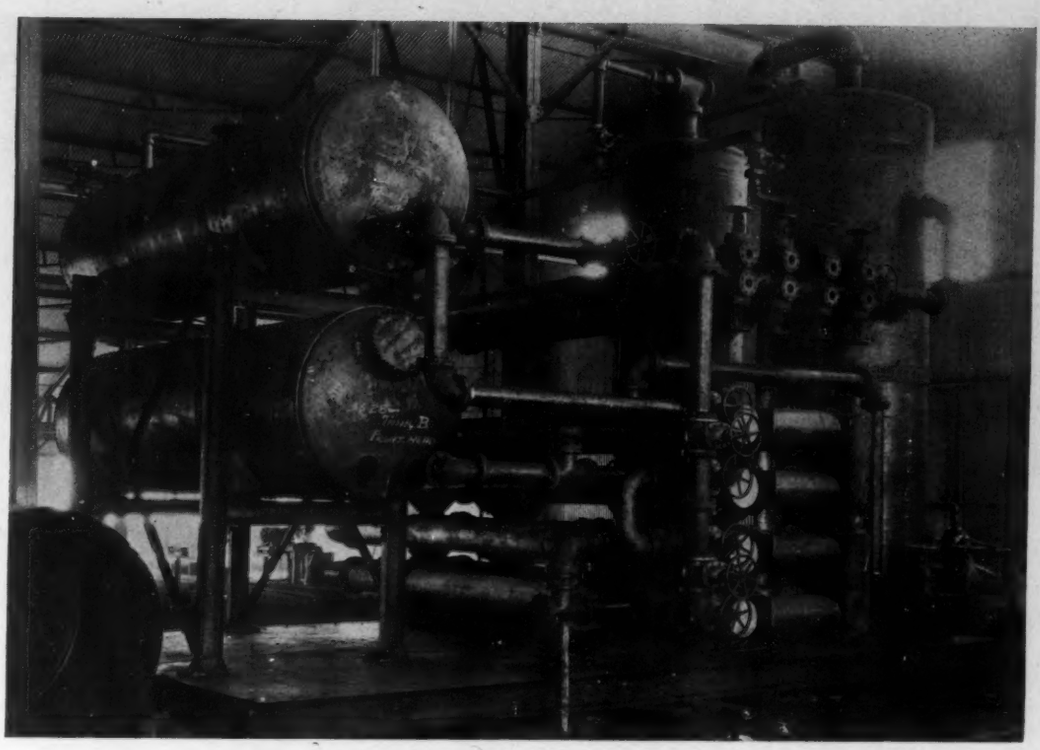
tion, is 96 feet wide by 200 feet long. In designing it particular attention was given to lighting, heating and ventilating.

The foundry operations are performed on the main floor. The casting store room, sand storage, locker, shower and wash rooms are located in the basement.

The machinery and work centers are laid out on the "straight line plan" and co-ordinate in such a manner that the sequence of operations, from the unloading of the raw materials to the delivery of castings to the machine shop, is accomplished in an efficient manner.

The railroad siding runs parallel to the building. Metal and sand are unloaded from the cars by gravity chutes, into the metal room.

The brass and bronze mixtures are melted in three electric furnaces, having a combined capacity of 2500 pounds per hour. The white metal and aluminum mixtures are melted in a gas-fired furnace. When the metal has reached the correct pouring temperature, as indicated by electrical instruments, it is poured into specially designed pouring

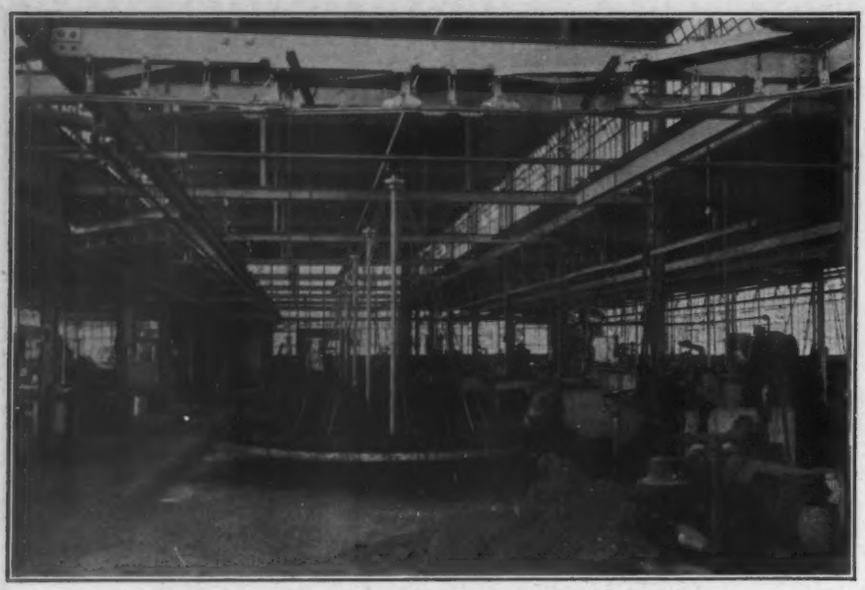


A Complete Distillation Unit being set up in our modern shops to customer's specifications

TULSA TYPE EQUIPMENT

TULSA BOILER & MACHINERY COMPANY

2020 SOUTH UNION, TULSA, OKLAHOMA



A ROW OF MOLD TURN-TABLES AND POURING TRACKS

ladles and conveyed to the mold turntables on a system of tracks designed and installed by the Louden Company.

The ladles, which are of original design by the Metric Metal Works, are being adopted as standard by many of the brass foundries of the country. They are insulated in such a manner that the metal can be held at the correct pouring temperature for a long period, so that in case of breakage there is no danger to the operator.

Cores are made on compressed air core machines and are baked in ovens. The ventilating and firing chamber design was made by the Metric Company. The ovens are equipped with combination oil and gas burners.

Most of the castings are made on air-squeeze type machines, using match plates. In back of each machine is a turntable on which the molds are placed. When a table has been filled with molds, metal is dispatched to it. While a helper turns the table, the "pourer" who stands upon it, fills each mold with the correct amount of metal. The empty ladle is returned to the furnace for refilling, on a track which runs parallel to the "pouring track." When the castings have been taken from the molds the sand is tempered, blended and riddled for future use. The sand is riddled by gyratory sieves and blended by a special blender. The turntables used by the Metric Metal Works were designed by this company several years ago. They have since been adopted by many brass foundries. Short orders and castings of intricate design are made by skilled bench molders.

The castings are cut from the gates and sandblasted, where every particle of grit and scale is removed. They are then placed in boxes and conveyed to the grinders and inspectors on a roller conveyor. After a careful inspection the castings are counted and weighed. They are then sent to the stock room in the basement on a spiral conveyor, or, in the case of castings to be tinned, started along the conveyor to the tinning department.

To insure a tight joint, all castings to be soldered are first coated with a "tinning mixture" composed of 50 per cent tin and 50 per cent lead. The tinning operation is accomplished by placing the castings in iron dippers, dipping them in acid, then plunging them into the molten tin bath. They are then cooled and conveyed to the stock room on the spiral. The tinning department is equipped with two furnaces, each with a capacity of 1500 pounds of metal, and fired by means of combination gas and oil burners.

Patterns are stored on numbered steel racks and are indexed according to name and number.

After the weights and numbers of castings have been recorded on the stock records they are stored in designated bins and boxes. Upon orders from the brass machine shop they are trucked through the subway, taken on an elevator and delivered direct to the machines.

Andrews-Bradshaw, Merges With Blaw-Knox

Pittsburgh—Merger of the Andrews-Bradshaw Company of this city with the Blaw-Knox Company has just been announced. The Andrews-Bradshaw Company is a Pennsylvania corporation, the main offices of which are in Pittsburgh, but the company has representatives in all parts of the United States and in all principal foreign countries. The main product of this company is the Tracyfier, a device for cleaning steam, gas, air and vapor. The Tracyfier is widely used in boiler plants and refineries.

No change in the organization of the Andrews-Bradshaw Company is contemplated, with the exception that the products of the company will be manufactured in the main plant of the Blaw-Knox Company at Blawnox, Pennsylvania. The Andrews-Bradshaw Company will operate as the Andrews-Bradshaw division of the Blaw-Knox Company.

Catalogs-Bulletins

TAYLOR INSTRUMENT HANDBOOK

Taylor Instrument Companies, Rochester, New York, announces the publication of a "Handbook of the Petroleum Industry," by S. S. Amdursky, M. E., in collaboration with L. G. Marsh, A.B., and E. N. Hurlburt.

The book is divided into three parts: (a) The production of crude petroleum, (b) the refining of crude petroleum, and (c) the manufacture of natural-gas gasoline.

Under each division is given a limited descriptive outline of various processes, with a corresponding reference to specific points for the application of instruments in all processes where instruments are necessary to insure uniformity of quality and economy of production. This involves particularly the instruments designed for the measurement or control of temperatures and pressures.

Part two of the book gives in a general way the more common routine laboratory practices or tests applied to crude petroleum and its different refined products.

Part three is a collection of tables intended to give those connected with the testing and refining of petroleum products complete and authoritative information connected with the use of instruments.

Copies of the book can be obtained from the Taylor Instrument Companies, Rochester, New York.

STRUTHERS-WELLS BULLETIN

A new bulletin is being distributed by the Struthers-Wells Company, Warren, Pennsylvania, describing the five standardized types of heat exchangers made for oil refineries, chemical and process work, etc.

It is said that these heat exchangers are characterized by their high fluid and vapor velocity, their well developed turbulence, removal tube bundle, and their full allowance for expansion and contraction.

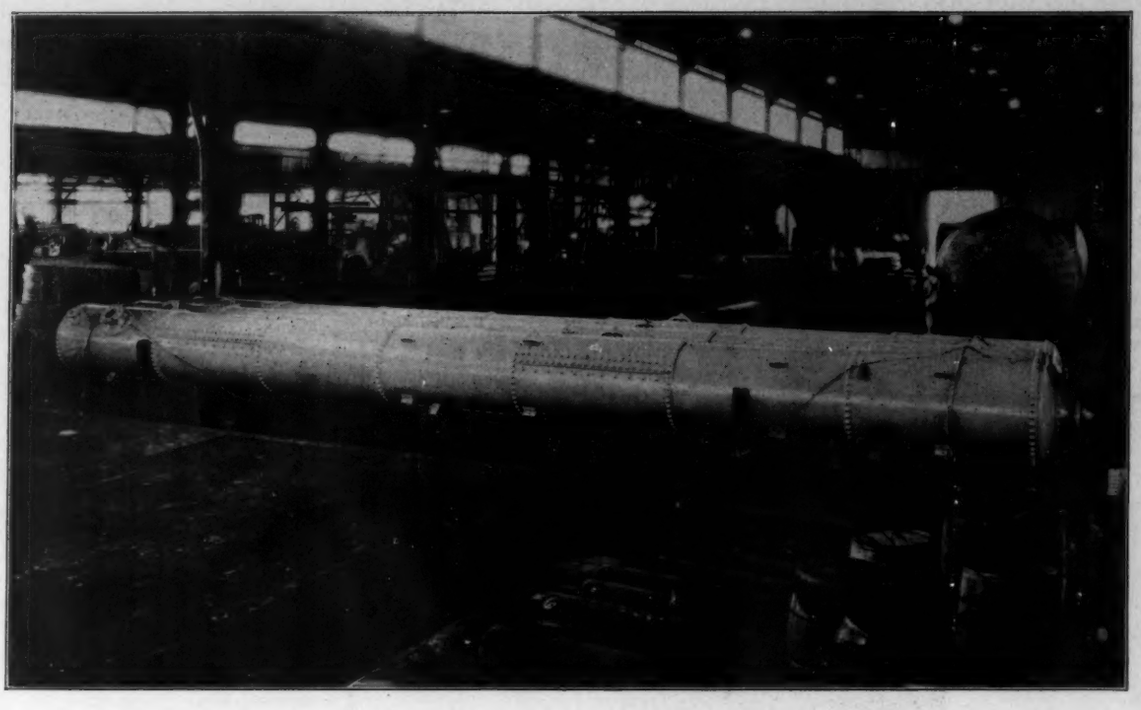
Copies of the bulletin will be mailed on request to the company.

CELOTEX INDUSTRIAL INSULATION

"Celotex Industrial Insulation" is the subject of a new booklet published by the Celotex Company, Oil Industries Division, Chicago.

The bulletin is filled with information on tank insulation and is illustrated with pictures taken in the field, largely. Results of widespread research on corrosion of steel storage tanks are stated in the book, and every petroleum engineer will find much of value in the data.

Copies of the publication can be obtained from the company, by request.



A Well Equipped Plant

With a floor space of 100,000 square feet and a modern plant adequately equipped, the Wyatt Metal & Boiler Works is fully prepared to serve the needs of refiners and gasoline manufacturers in this district.

Wyatt's carries a large tonnage of flat plates in thickness from 16 gage to 1 foot and flat circles for making flanged heads up to 120" in diameter. Also flanged and dished heads from 24" diameter to 120" diameter and from 5/16 to ¾-inch in thickness.

These facilities represent a large investment and are available to serve you in the same satisfactory manner they have served practically every refiner and manufacturer of Natural Gasoline in this territory.

Wyatt Metal & Boiler Works

Dallas, Texas

SOOT BLOWER BULLETIN

"National" Soot Blowers, made by the National Flue Cleaner Company, Groveville, New Jersey, are described in a bulletin just issued and now ready for distribution.

These blowers are designed for use with horizontal return tubular and Scotch marine boilers, and they employ a separate nozzle in a fixed position for each boiler tube. The blower is located in the front of the boiler and is operated from the floor level, the tubes being cleaned in four sections, in turn. Where the up-take is in the back of the boiler, and the hot gases make a third pass over the top of the boiler shell, batteries of nozzles are also provided for cleaning the shell. It is said that the blowers can be operated with either steam or compressed air.

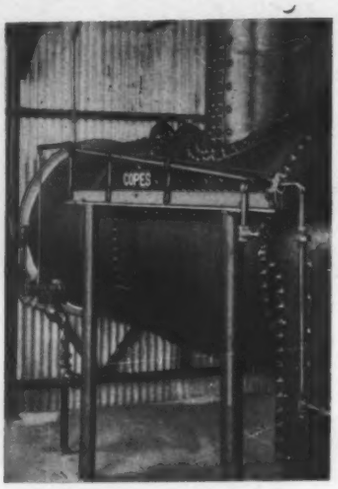
Copies of the bulletin can be obtained from the manufacturers.

BECO BOILER BAFFLE

The Boiler Engineering Company, 931 Federal Trust Building, Newark, New Jersey, has published a new bulletin on BECO boiler baffle walls. Numerous illustrations show the wall installed.

The company also announces that it now owns and controls the Turner Baffle Wall and can supply customers with either the BECO or the Turner.

Copies of the bulletin may be had on request to the company.



COPES
Feed Water Regulators
provide—

A simple, rugged, accurate and continuous boiler feed water input.

Even distribution of load between boilers.

Less drop in steam pressure on overloads.

Higher overload capacity.

Smooth, constant rate of feed with no spasmodic opening and closing of the feed valves.

Drier steam, since the water level cannot rise beyond a predetermined point.

Elimination of boiler priming and wet steam at the filter department.

Labor saving.

Reduced stress on boiler feed pumps, feed lines and valves.

Send for a copy of "Advantages of Boiler Feed Water Regulation in the Oil Industry" written by L. L. Baker, Chief Engineer of the Barnsdall Refining Company.

NORTHERN EQUIPMENT CO., 620 Grove Drive, Erie, Pa.

Stock carried by:
B. W. Vinson, 422 Wright Building, Tulsa
C. C. Moore & Co., Engineers, Central Bldg., Los Angeles

HIGH TEMPERATURE INSULATION

Celite Products Company, 1320 South Hope Street, Los Angeles, announces publication of a lecture called "High Temperature Insulation," in booklet form. The lecture is being used by leading engineering schools throughout the country. The subject matter includes data on methods of measuring heat flow through walls as well as temperature gradients and heat losses through typical insulated and uninsulated walls. Drawings are included, showing methods of insulating various types of high temperature equipment, such as boilers, furnaces, blast furnace stacks, open-hearth regenerators, flues, etc. Copies can be had upon request from the company.

INDUSTRIAL METERS

Badger Meter Manufacturing Company, Milwaukee, Wisconsin, is distributing a bulletin describing Badger Industrial Meters. The publication gives full particulars on all classes of meters made and sold by the company. Copies will be mailed on request to the company, or to the Specialty Meter Division, 30 Church Street, New York City.

INSULATION FACTS

Lyndhurst, N. J.—United Cork Companies of this place has published a handbook entitled "Facts and Figures on Insulation," which is intended to supply the refrigerating industry and others interested in insulation with dependable data about pure cork board and the modern methods of its erection. The booklet is of standard filing size.

TORCHWELD CATALOG

Torchweld Equipment Company, 224 N. Carpenter Street, Chicago, Illinois, is distributing catalog No. 28. The catalog contains considerable data on gas welding and cutting equipment. Several new models in Torchweld products are features. Copies of the catalog can be had by writing the company.

JET SIPHONS AND EDUCTORS

Schutte-Koerting, Philadelphia, Pennsylvania, has published a new bulletin on steam jet syphons and water jet eductors, for lifting and pumping fluids. Cross sectional drawings of the devices are shown in red illustrating operating principles.

Copies of the bulletins can be had by writing the company.

ALFIT PACKING MATERIAL

Alfit Packing Company, 299 Broadway, New York City, New York, has published a booklet describing Alfit Packing material—a dough-like all me-

12,000,000 Barrel Tankage

Painted with

SILVR - COOL

The Super-Aluminum Paint

The evaporation losses on this tankage have been cut to a minimum through the application of Silvr-Cool.

The dollars and cents savings affected by this company over a period of a few years have paid many times for the cost of applying Silvr-Cool.

Four of the World's largest producers and marketers have used Silvr-Cool for several years resulting in substantial reductions in their per year cost for maintenance.

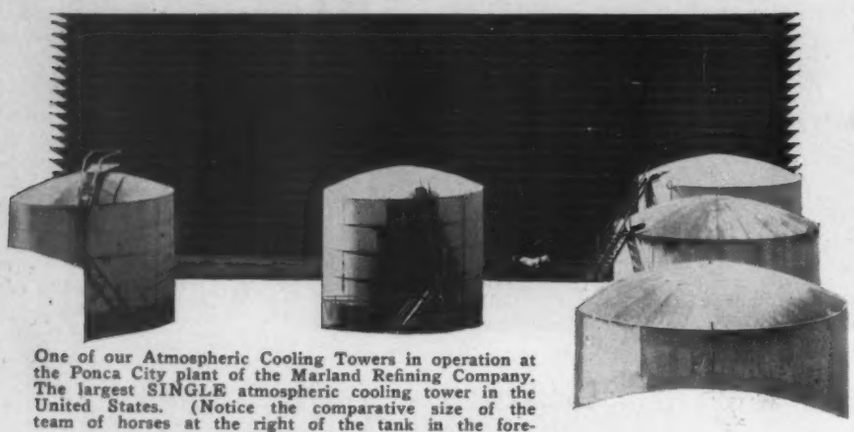
It is not only logical, but has been proven by actual tests in the field that Silvr-Cool—the Super Aluminum completely mixed paint, manufactured by modern machinery, in accordance with a carefully compounded formula is superior to mixed on the job paint. The elements of hand mixing and guess work are eliminated.

An interesting and helpful booklet on the care and maintenance of tankage will be sent upon request.

SILVR-COOL

Detroit Graphite Company

DETROIT, U.S.A.



One of our Atmospheric Cooling Towers in operation at the Ponca City plant of the Marland Refining Company. The largest SINGLE atmospheric cooling tower in the United States. (Notice the comparative size of the team of horses at the right of the tank in the foreground.)

When You Must Choose Between a Cooling Tower and Spray Pond

THE REFINERY ENGINEER must often choose between a cooling tower and a spray pond when it comes to installing water cooling equipment. For many years we have been manufacturing and installing both cooling towers and spray ponds for refineries and can advise you intelligently as to which is the best type for your purpose.

We have designed and built cooling towers and spray ponds for firms like Marland Refining Co., Union Oil Co., Roxana Petroleum Co., and others equally well known.

Write for These Bulletins

Bulletin 273-R. Cooling Towers.
Bulletin 262-R. Spray Ponds.
Bulletin 255-R. Air Filters.
Bulletin 277-R. Air Washers.

THE COOLING TOWER COMPANY, INC.

15 JOHN STREET NEW YORK

Local Representatives:

Houston, Texas
The J. A. Rossiter Co.,
410 Union Nat'l Bank Bldg.

Shreveport, La.
Pelican Well Tool & Supply Co.

Tulsa, Okla.,
N. M. Muir,
Kennedy Bldg.

Los Angeles, Calif.,
N. O. Fleming Co.,
5815 Maywood Ave.,
Huntingdon Park

Representatives in Other Principal Cities.

One of our spray nozzle cooling systems in operation at an oil refinery in Louisiana.

The Spiral Motion Is the Trick

That's why Hood's Chemico Spiral Packing Rings have been selected by so many engineers. The center hole prevents choking and clogging.

Made of acid-resisting shale—practically indestructible.

Used by all big producers because of the intensive movements.

Samples on request.

B. MIFFLIN HOOD BRICK CO., Atlanta, Ga.

tallic packing for all kinds of service where packing is required. Copies of the bulletin will be mailed on request to the company.

SUPERHEAT ENGINEERING

Superheat Engineering Data, a supplement to the sixth edition, is a publication recently released by the Superheater Company, 17 East 42nd Street, New York. The publication is a handbook on the generation and use of super heated steam and related subjects. Copies can be had on request to the company.

BUREAU BULLETIN

Serial 2837, United States Bureau of Mines, Department of Commerce, Washington, D. C., is ready for distribution to those interested in the study of heavier hydrocarbons. Particular emphasis is given those hydrocarbons boiling above 300 degrees C., with the study being made with Salt Creek, Wyoming, crude oil. The work was done by H. M. Smith, assistant petroleum chemist, Bureau of Mines.

Manufacturers' Notes

GRAVER'S NEW TEXAS OFFICE

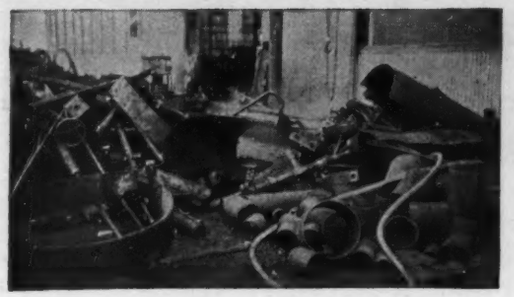
Effective January 1, 1928, Graver Corporation anonunced the establishing of Texas headquarters at 201-2 Petroleum Building, Fort Worth. The office formerly located in the West Building, Houston, has been discontinued.

The Fort Worth office will be a full branch office with complete personnel for handling the Graver line. T. C. Crosby, formerly of the Tulsa office, will handle sales of tanks and steel plate equipment; H. E. Clark, formerly of the Houston office, will handle the sales of Jenkins Cracking Process and other refinery equipment; C. J. Hutcheson, formerly of East Chicago, will handle the sales of water softening and filtering equipment.

Dallas.—The oil industry department of Johns-Manville, Inc., is now located here at 1116 Magnolia Building, having been moved to Dallas from Houston. E. M. Naylor, special representative, is in charge of the department.

AMERICAN RADIATOR MERGER

Forming one of the largest concerns of its kind in the world, the American Blower Company and the American Radiator Company were recently merged. The chief purpose of the merger was to make possible important economies in buying, marketing and manufacturing; in other respects there will be very little change in the conduct of the business of each of the



Just junk ?

or can it be salvaged?

EQUIPMENT covered with heavy coatings of oil and muck often *looks* ready for the scrap heap when actually it is worth repairing. But before proper inspection can be made, thorough cleaning is necessary.

Heretofore, this has meant long hours of tedious, costly hand labor with gasoline or other distillates. But no longer. For now a short soak in an Oakite cleaning solution removes every trace of muck *without hand scrubbing*. Valves, fittings, bits, fishing tools and other parts are cleaned *in quantity* —made ready for repairs in a small fraction of the time formerly required. *Salvage operations are on a new efficiency basis!*

Our booklet, "Oakite in the Oil Industry", goes into details. Let us send you a copy.

Oakite is manufactured only by
OAKITE PRODUCTS, INC., 50B Thames St., NEW YORK, N. Y.

Oakite Service Men, cleaning specialists, are located at

Albany, N. Y., Allentown, Pa., *Atlanta, Altoona, Pa., Baltimore, *Birmingham, Ala., *Boston, Bridgeport, *Brooklyn, Buffalo, *Camden, N. J., Charlotte, N. C., Chattanooga, Tenn., *Chicago, *Cincinnati, *Cleveland, *Columbus, O., *Dallas, *Davenport, *Dayton, O., Decatur, Ill., *Denver, *Des Moines, *Detroit, Erie, Pa., Flint, Mich., Fresno, Cal., *Grand Rapids, Mich., Greenville, S. C., Harrisburg, Pa., Hartford, *Houston, Texas, *Indianapolis, *Jacksonville, Fla., *Kansas City, Los Angeles, Louisville, Ky., *Memphis, Tenn., *Milwaukee, *Minneapolis, *Moline, Ill., *Montreal, Newark, N. J., Newburgh, N. Y., New Haven, *New York, *Omaha, Neb., *Oakland, Cal., *Philadelphia, *Pittsburgh, Portland, Me., *Portland, Ore., Providence, Reading, Pa., *Rochester, N. Y., Rockford, Ill., *Rock Island, *San Francisco, *Seattle, South Bend, Ind., *St. Louis, *St. Paul, Syracuse, N. Y., *Toledo, *Toronto, Trenton, *Tulsa, Okla., Utica, N. Y., *Vancouver, B. C., Williamsport, Pa., Worcester, Mass.

*Stocks of Oakite materials are carried in these cities.

OAKITE
TRADE MARK REG U.S. PAT OFF.
Industrial Cleaning Materials and Methods

CROSBY Relief Valves

Crosby JJ Type Relief Valve for High Temperatures and Pressures up to 1500 Pounds.

Provide Maximum Discharge Capacity

CROSBY JJ type Relief Valves have a discharge capacity of 98% of the theoretical discharge of orifice. This extremely high capacity is obtained by means of the nozzle-shaped throat tube and the Crosby design which places guides out of the way above the disc.

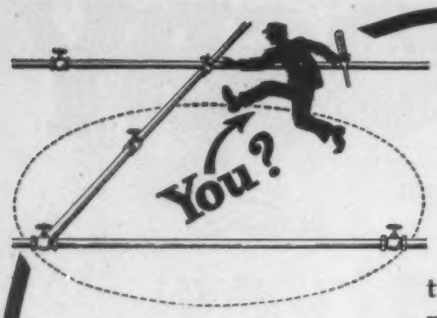
These valves are non-sticking at high temperatures because all parts are of the same metal and have the same expansion. They are non-fouling because guides are removed from contact with sediments and deposits. They are extra durable because made of the best materials, and non-chattering when properly installed.

Widely used, with eminent satisfaction, on pressure stills, cracking coils and hot and cold oil lines.

Crosby Steam Gage & Valve Co.

"50 Years of Dependable Service"

Distributors:
WESTCOTT & GREIS, INC.
DALLAS TULSA LOS ANGELES



Do You Maintain Temperatures on the Run?

Do you maintain temperatures by the old-fashioned method—hour after hour and day after day making the rounds and turning valves up or down? Leg-work isn't efficiency. Guessing at valve regulation is pure gambling—costly in employes' time, expensive in quality and quantity of production and costly in goods ruined.

Why not follow the methods used by modern plants and install Sarco Automatic Temperature Regulators? Simply set a Sarco to any definite temperature from 30 to 300 degrees. Then forget it and let the Sarco control your temperatures without further supervision.

Sarco is entirely self contained. Requires no outside attachments or operating medium such as electricity, compressed air or water pressure. And it works with equal perfection on steam, gas or hot water lines.

30-Day Free Trial

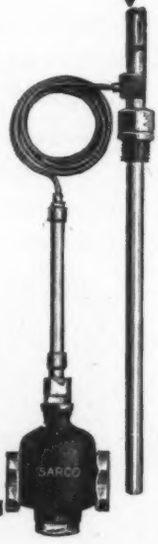
Let us send you a Sarco on Free Trial. If it doesn't prove its case and sell itself to you within thirty days, return it to us and the trial won't cost you a cent.

Booklet S-99 Sent on Request.

SARCO CO., Inc.

183 MADISON AVE., NEW YORK, N. Y.

BOSTON CLEVELAND BUFFALO DETROIT
CHICAGO PHILADELPHIA



SARCO Temperature Regulator

A FACT

There is just one packing requirement Crandall can *not* fill—and that's for the man who wants *cheapness* without regard to service, economy, or *safety;* for Crandall packings have *proven* themselves to be

VALUE FIRST

CRANDALL PACKING COMPANY
O. J. GARLOCK, *President and General Manager*
PALMYRA, NEW YORK
No affiliation with any other concern selling the consumer.

National Service

NEW YORK
CHICAGO
BOSTON
PHILADELPHIA
CLEVELAND
PITTSBURGH
KANSAS CITY
DETROIT
BIRMINGHAM
ST. LOUIS

and Immediate Service.

two companies, each operating as before under the same name, personnel, business methods and management. The products of the two companies include heating, ventilating, air conditioning, and mechanical draft apparatus and allied lines.

General offices of the American Radiator Company are in New York City, while the main plant is in Buffalo. Executive offices of the American Blower Company are in Detroit, and the manufacturing plants are in Detroit and Cincinnati.

Dallas.—Southwestern district offices of the Griscom-Russell Company have been established here at 305 Magnolia Building, with K. B. Ris in charge.

BRAUN GETS CONTRACT

C. F. Braun & Company of Los Angeles were awarded contract for construction of the new $125,000 gasoline absorption plant of Moody & Seagraves at Waskom, Texas. The location of this plant is near a booster station of the 22-inch gas line of the Dixie Pipe Line Company leading from Louisiana to Houston. The Moody & Seagraves absorption plant will have a capacity of about 15,000 gallons of gasoline daily.

Norman F. Kimball has been selected as manager of advertising for the American-LaFrance & Foamite Corporation, which is a combination of the American-LaFrance Fire Engine Company and the Foamite-Childs Corporation.

HENDRICK CHICAGO OFFICE

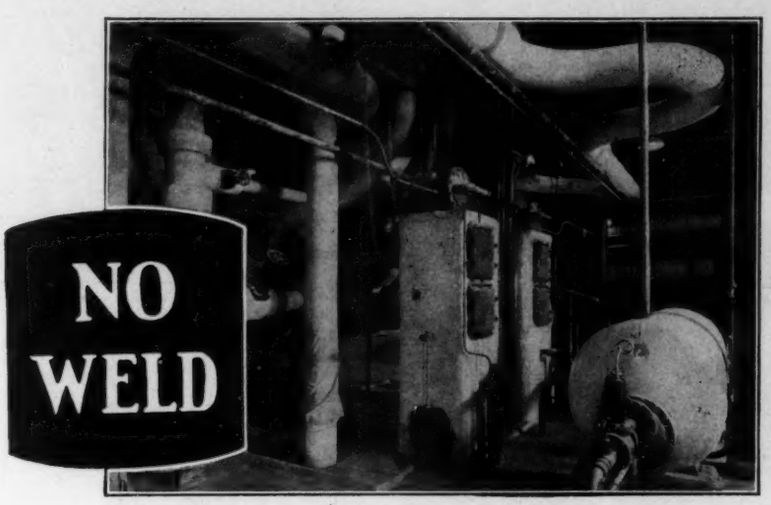
Hendrick Manufacturing Company, Carbondale, Pennsylvania, manufacturers of Mitco Interlocked Steel Grating, Mitco Shur-Site Stair Treads and Mitco Armorgrids, announces the opening of a Chicago District Office, 223 Railway Exchange Building, Chicago, in charge of Lon Sloan. Mr. Sloan's extensive floor grating experience is available to those concerned with the selection of floor grating, stair treads and armorgrids for reinforcing concrete floors, platforms and driveways.

BOTFIELD REPRESENTATIVE

Botfield Refractories Company, Philadelphia, Pennsylvania, manufacturers of Adamant Fire Brick Cement, announces the appointment of Ires Prosser as Southeastern representative. Mr. Prosser's territory will embrace the entire Southeast from North Carolina to San Antonio, Texas. His headquarters will be Atlanta, Georgia.

Use More Seamless Steel Tubing
Here are *Eight Reasons Why*

Reason Number 3



The eight reasons are—

1. Steel of any desired analysis
2. Uniform texture of the metal
3. No weld
4. Maximum strength
5. No weak spots
6. Minimum internal strains
7. Longer life
8. Safety

Each of these eight reasons will be the subject of an individual advertisement.

EVERY inch of weld in a welded tube or pipe is a point of potential failure. The expansion and contraction, especially at bent sections, frequently causes a rupture of the weld—the weakest point of welded pipe.

Pittsburgh Seamless Steel Tubes and Pipe have no weld because they are made by piercing and rolling solid billets of basic open hearth steel. This process gives the steel a severe working that conditions the steel. The tubes are made of stronger steel, and there are no weak spots at any points. Consequently seamless steel tubing is safer and more economical than welded tubing for important piping.

For more than 20 years our entire resources have been focused on one objective—how to make a better seamless tube. Today our methods are the most up to date that engineers and scientists have developed. Due to this carefully concentrated attention on only one type of tubing, we have become the largest company in America devoted exclusively to its manufacture.

Your inquiry sent to one of the following offices will be given immediate attention.

Pittsburgh Seamless tubing and pipe can be used to advantage for—

Still Tubes
Boiler Tubes
Superheater Tubes
Arch Tubes Dry Pipes
Water Wall Tubes
Condenser Tubes
Line Pipe
Heating Systems
Tank Car Piping
Steam Lines
All High Pressure Piping

Available in all sizes up to 13⅜ O. D. including pipe sizes.

Pittsburgh Steel Products Co.
DIVISION OF
Pittsburgh Steel Co.

PITTSBURGH · NEW YORK · DETROIT CHICAGO · HOUSTON · TULSA

Pittsburgh Seamless

Seamless Steel Tubes are the modern standard for all tubular needs.

Adopt "Pittsburgh Seamless" now and benefit by its safety and economy

Mention Where You Saw the Advertisement

Abstracts of Technical Literature
Of Particular Interest to the Plant Operator

Progress in Refining in 1927.—(*Samans. Mech. Eng., Vol.* 50, *No.* 1, *pp.* 45-48.) *Author discusses* 1927 *refinery progress under five sub-headings*:

(1). *Savings possible in manufacture.* Reduction in evaporation losses by more extensive use of such modern equipment and methods as gas-tight roofs, breather vents fitted with flame arresters, breather-bags, floating roofs, by insulation of roof or by maintaining a slight pressure on contents of tank; reduction of fuel consumption by more extensive use of pipe-stills and re-design of furnaces used with shell-type stills, by use of instruments for controlling fuel and air, by recirculation of flue gases, by design of furnaces to take advantage of radiant heat and convection heat in the best possible manner, by the proper use of insulating materials and by the installation of tubular heat-exchangers.

A simple way around corrosion troubles

THE handling of acids and clays in the refinery should be carried on in a material that is not corroded or abraded in this service.

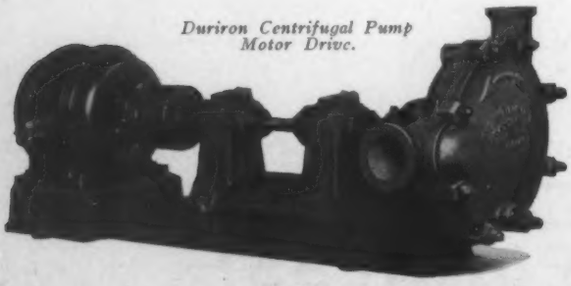
Duriron is highly acid resisting, and is so hard that its surfaces are not scored by cutting abrasives.

With Duriron as a material of supply, and with an organization that has specialized for many years on industrial problems of corrosive handling, we have developed a line of pumps, valves, piping, jets, nozzles, etc., that eliminates maintenance and assures high production.

The first cost of apparatus is of small consequence provided repairs, replacements, *and the time taken to make them* are banished.

Duriron stands the acid test. It should be a part of your equipment.

Duriron Centrifugal Pump Motor Drive.



DURIRON centrifugal pumps are made in a variety of sizes to handle any requirements of the refinery. They are rugged and simple in construction, and they offer a solution to many vexing acid handling problems.

Duriron is produced only by

The DURIRON COMPANY DAYTON·OHIO

(2) *Construction and engineering problems.* Use in 1927 of forge and electric-welded chambers for cracking processes in greater thicknesses than previously; growing tendency to inspect regularly all refinery equipment from the standpoint of safety and efficiency; construction of almost all equipment for permanence and fire resistance; more extensive use of alloy-metals and of methods for protecting materials from corrosion.

(3) *The various processes in vogue.* More extensive use of pipe-still and modern fractionating equipment, so that few products have to be re-run; wider use of vacuum-distillation methods in making lubricating oils and use therewith of multi-stage thermo-compressors, whereby the steam is recovered and the overall efficiency of the apparatus thus improved; improvements in the methods of operating cracking processes, one of the foremost of which is the charging of crude oil directly to cracking apparatus, thereby removing in one operation both the natural and the cracked naphtha with possibly less loss than by carrying out the fractionation of the natural naphtha separately from the cracking apparatus; increasing experiment in and development of vapor-phase cracking processes; installation of two plants in this country of the clay-pulp method of contact filtration; further developments in dry-clay method of contact filtration; more efficient burning of course-mesh fullers earth, due to growing use of either Herreschoff or Wedge-type furnaces; use of Edelaneau method of refining oils with liquid sulfur dioxide, a method gaining favor on the Pacific Coast; broader applications of centrifugal method of dewaxing oils; and more extensive use of method of physical treatment of gasoline vapors by passing same through a bed of fullers earth, as per Gray's vapor-phase treating process.

(4) *Developments in the manufacture and use of steam and power.* Less process steam is being required for distillation; more power-generating capacity is now needed, partly due to the more extensive use of electric power applied through gear drives; economies in operation are being attained by use of high-pressure boilers and carrying of higher pressure in steam-distribution mains; and, further, pump designs have been improved.

(5) *Research work under way.*—Distillation of coal (Bergius process); efforts to improve application of radiant heat in combustion chambers; and recovery of a greater portion of the by-product gas from petroleum distillation than is now being obtained.

Distillation

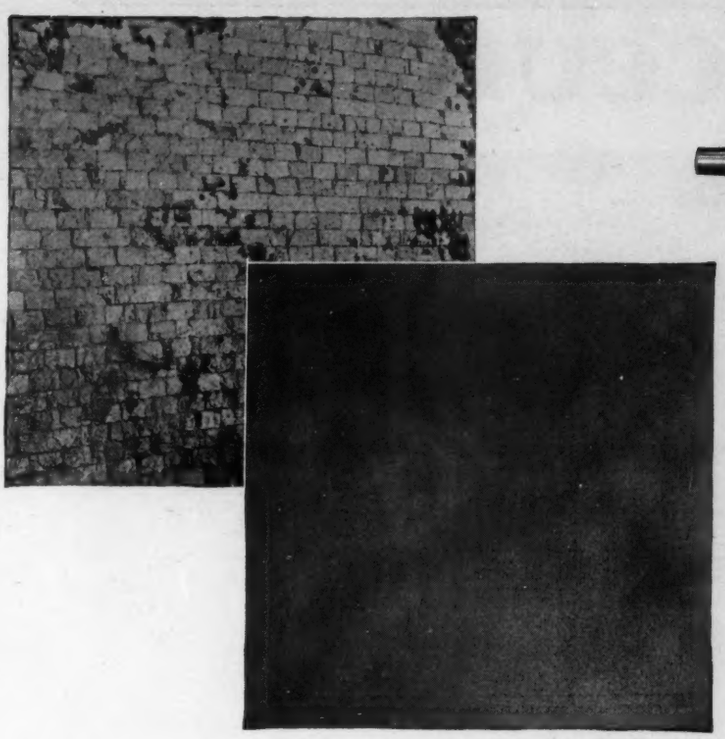
Scheme of a Gasoline Topping Plant for Diatomic Crude from Binagady.—(*G. A. Sarkissiantz, Azerbeidyanskoye Neft. Khoz.* 1927, *No.* 2, 69-72, *C. A. Nov.* 10, 1927, *p.* 3736). In a proposed plant for a continuous distillation of gasoline the still is heated with superheated steam (170 degrees C.) in 2 sets of coils covered with corrugated-iron sheets. The

ADAMANT DISTRIBUTORS

Alabama, Birmingham,
Young & Vann Supply Co.
California, Los Angeles
Industrial Supply Co.
California, San Francisco,
W. E. Mushet Co.
Colorado, Denver,
H. W. Thompson
Connecticut, Hartford,
Factory Supply Co.
Connecticut, New Britain,
Rackliffe Bros. Co., Inc.
Connecticut, New Haven,
The Warner-Miller Co.
Illinois, Chicago,
Wm. E. Dee Co.
Indiana, Fort Wayne,
Coan Equipment Co.
Indiana, Indianapolis,
Indianapolis Belting & Supply Co.
Iowa, Des Moines,
Walredh Supply Co.
Kentucky, Louisville,
E. D. Morton & Co., Inc.
Kentucky, Paducah,
Henry A. Petter Supply Co.
Louisiana, New Orleans,
Woodward, Wight & Co., Ltd.
Louisiana, Shreveport,
Woodward, Wight & Co., Ltd.
Maryland, Baltimore,
King's Coal & Supply Co., Inc.
Massachusetts, Boston,
Waldo Bros. & Bond Co.
Massachusetts, Springfield,
Oscar F. Carlson
Massachusetts, Worcester,
Waldo Bros. & Bond Co.
Michigan, Detroit,
H. D. Edwards & Co.
Minnesota, Duluth,
Duluth Builders Supply Co.
Minnesota, Minneapolis,
Northern Machinery & Supply Co.
Missouri, Kansas City,
Union Material & Supply Co.
Missouri, St. Louis,
Reed Railway Supply Co.
Nebraska, Omaha,
American Machinery & Supply Co.
New York, Buffalo,
The Curtis Supply Co.
New York, Mohawk,
American Hard Wall Plaster Co.
New York, New York,
C. C. Phillips, 110 W. 34th St.
New York, Rochester,
American Clay & Cement Corp.
Wm. Summerhays & Son
New York, Rome,
American Hard Wall Plaster Co.
New York, Syracuse,
Paragon Plaster Co.
New York, Utica,
American Hard Wall Plaster Co.
North Carolina, Asheville,
Southern Steel & Cement Co.
Ohio, Cincinnati,
Wm. T. Johnston Co.
Ohio, Cleveland,
Cleveland Tool & Supply Co.
Ohio, Columbus,
Westwater Supply Co
Ohio, Dayton,
Klinger-Dills Co.
Ohio, Toledo,
Toledo Builders Supply Co.
Oklahoma, Tulsa,
Standard Asbestos & Cork Co.
Oregon, Portland,
M. L. Kline Co.
Pennsylvania, Bethlehem,
Morris Black
Pennsylvania, Erie,
O. C. Thayer & Son
Pennsylvania, Pittsburgh,
Pittsburgh Supply Co.
Pennsylvania, Reading,
Reading Foundry & Supply Co.
Rhode Island, Providence,
B. & H. Supply Co.
South Carolina, Columbia
Columbia Supply Co.
South Carolina, Spartanburg
Spartanburg Mill Supply Co.
Tennessee, Memphis,
Reed & Duecker
Texas, Beaumont,
Norvell-Wilder Hardware Co.
Texas, Corpus Christi,
San Antonio Machine & Supply Co.
Texas, Dallas,
The Murray Co.
Texas, El Paso,
Geo. S. Thomson Co.
Texas, Houston,
Norvell-Wilder Hardware Co.
Texas, San Antonio,
San Antonio Machine & Supply Co.
Texas, Waco,
San Antonio Machine & Supply Co.
Virginia, Norfolk,
Empire Machinery & Supply Corp.
Virginia, Richmond,
A. Lynn Thomas Co.
Washington, Seattle,
Crosin & Co.
Washington, Spokane,
Consolidated Supply Co.
West Virginia, Charleston,
South Side Foundry & Machine Works
Wisconsin, Milwaukee,
Tews Lime & Cement Co.
Wisconsin, Superior,
The Speakes Company

Canadian Distributors

British Columbia, Vancouver,
B. C. Equipment Co., Ltd.
Manitoba, Winnipeg,
Walter Belyea & Co., Ltd.
Ontario, Hamilton,
Thomson-Gordon, Ltd.
Ontario, Port Arthur,
Wells & Emmerson
Ontario, Toronto,
I. H. Morrison
Quebec, Montreal,
Alex. Bremner, Ltd.



Here is all there is to The ADAMANT Gun—enough to do the work speedily, efficiently and effectively. No tanks, pistons, or other complicated mechanism to clean in The ADAMANT Gun. Yet it costs but $25.00 in the U. S., and $32.00 in Canada.

Almost a New Wall! *With The* ADAMANT *Gun*

ON the side wall shown above, The ADAMANT Gun applied a coating of a pre-mixture of ADAMANT Fire Brick Cement and ADACHROME, finished off with a dust coat of *dry* ADACHROME, also blown on with The ADAMANT Gun. The other side wall, front wall and bridge wall were similarly treated. All joints, brick pores and cracks were filled and sealed, and the brickwork was provided with an even surfacing that is highly-refractory and exceptionally resistant to the adhesion of clinker, slags, fusible coal ash, fuel impurities and other destructive elements. Now the setting is ready for further service, although it was due for rebuilding. Think of the saving in relining expense alone!

You, too, can make your boiler furnace linings and still settings last longer, reduce your repairs and cut relining costs, if you use The ADAMANT Gun for applying ADAMANT-ADACHROME Mixtures. The cost is small, for the price of The ADAMANT Gun is but $25.00 in the U. S., and $32.00 in Canada.

Why not look into the matter? Let us send you booklets on ADAMANT Fire Brick Cement, The ADAMANT Gun and the ADAMANT-ADACHROME Mixtures. Write us.

BOTFIELD REFRACTORIES CO.

783 S. Swanson St., Philadelphia, Pa.

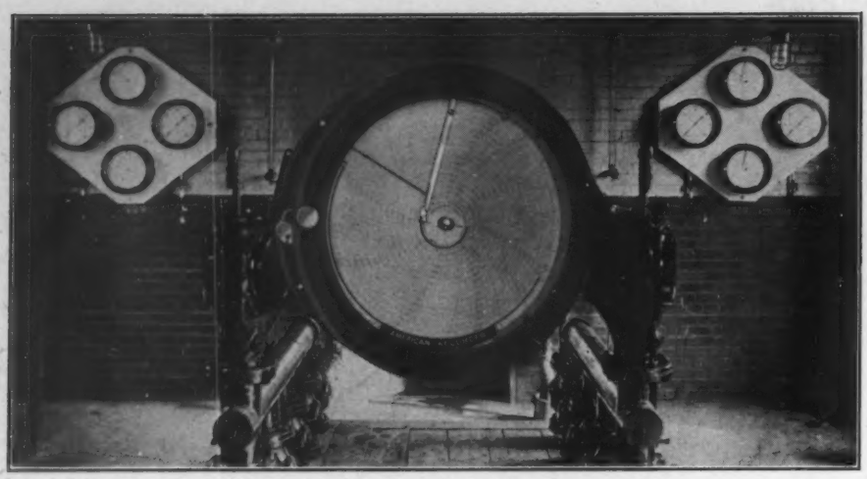
For A Long Furnace Run, Use The ADAMANT *Gun*

ADAMANT
FIRE BRICK CEMENT

Whenever You Use a Fire Brick, Use ADAMANT, *the Original High Temperature Cement*

Mention Where You Saw the Advertisement

ACCURACY



American Recording and Indicating Hydraulic Gauges in Pump House of Emery Refining Co., Bradford, Pa. Illustration in the center shows Type 3192 American Recording Gauge for all pressures up to 10,000 lbs.

If pressures are important, the instruments for measuring such pressures ought to be reliable and accurate. American Recording Gauges are guaranteed accurate. They are selected because long life and accuracy have been their characteristics since these instruments were first invented.

Write for the following:

Gauge Catalog A-19
Recording Gauge Catalog E-19
Thermometer Catalog F-19
Dial Thermometer Catalog G-19
Recording Thermometer Catalog H-19
Temperature Controller Catalog R-19
Steam Trap Catalog S-19
Tachometer Catalog J-19

AMERICAN INSTRUMENTS

American
Schaeffer & Budenberg
Corporation

338 Berry St., Brooklyn, N. Y.

BRANCHES IN PRINCIPAL CITIES

Makers of American Industrial Instruments since 1851

SOUTHERN CORNICE WORKS

Manufacturers of

"SOCO" STATIONARY AND REVOLVING VENTILATORS

For Refinery
And Natural Gasoline Plants

Oil Field Work A Specialty

Phone 2-1546 TULSA, OKLAHOMA 118-20 S. Cincinnati

crude oil is run by gravity from a tank, flows through jets and drops on the hot iron sheets. The partly stripped crude flows down and comes into contact with the sheets on the lower steam coil. The escaping gasoline vapor has a temperature of 150 degrees C. The stripped crude leaves the still through the bottom, passing a heat exchanger, to a storage tank. A bubble tower is provided to give close cuts of gasoline. Calculations, cost figures, a full description and a drawing of the plant are given.

Cracking

Cracking in the Liquid Phase at Atmospheric Pressure.—(*A. G. Zakharenko and K. V. Mistchenko, Azerbeidyanskoye Neft. Khoz.* 1927, *No.* 4, 42-50. *C. A., Nov.* 10, 1927, *p.* 3738). Fuel oil containing some water-white is not suitable for cracking under atmospheric pressure. Cracking begins after the stripping of the light ends (water-white) and raising of the oil temperature in the still to 380 degrees C. The rate of cracking doubles with every 10 degrees C. Not more than 50 per cent of the fuel oil should be distilled off; distilling of more than this makes it difficult to remove the residue left in the still. Too high temperatures are harmful to the still. Distilling curves and other data are given.

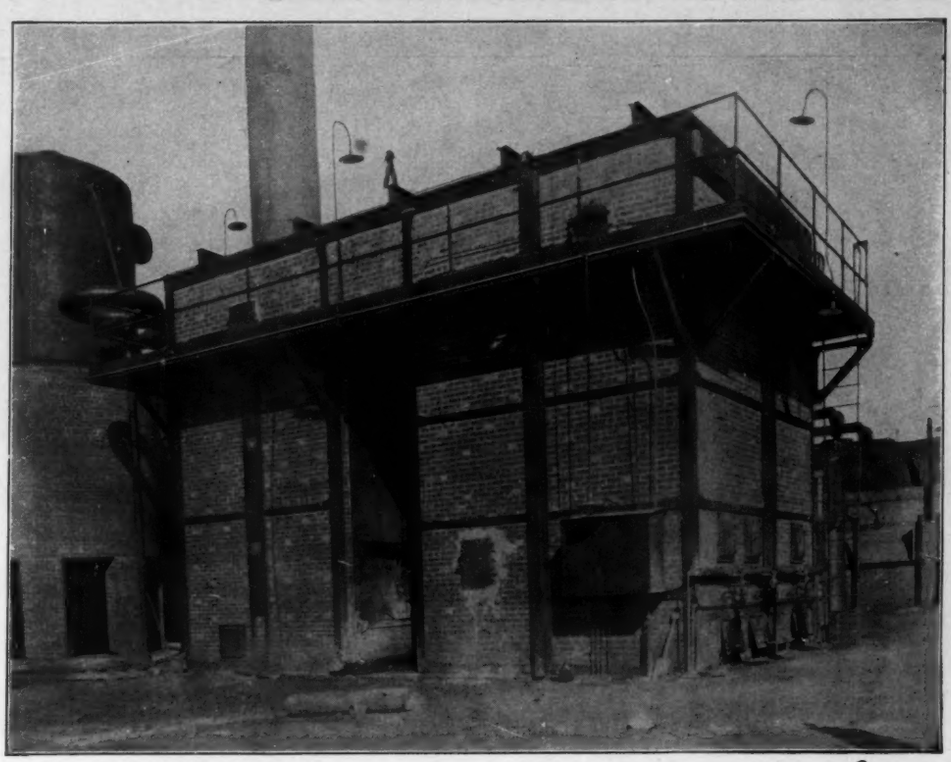
Fractionation

Rectification of Water-White Oil.—(K. *V. Kostrine, Azerbeidyanskoye Neft. Khoz.* 1927, *No.* 3, 35-46. *C. A., Nov.* 10, 1927, *p.* 3726). From his own experiments and from information from other sources Kostrine concludes that : (1) The yield of water-white distillate is increased considerably and color and mixture of fractions will be of a much higher grade if rectification columns are used for water-white distillation from crude oil. (2) The rectification columns eliminate from the water-white the heavy ends from the gasoline and the light ends from the solar-oil fraction. The phlegma is stripped off the light ends of the water-white. From gasoline they eliminate the light water-white fractions and from the phlegma, the gasoline. (3) Therefore both rectifying columns have to be provided with some equipment for additional evaporation for the phlegma. Superheated steam is used and an additional equipment for rectification. (4) The spray liquid has to be pumped to the top of the columns; it consists either of gasoline or water-white distillate. (5) The columns for gasoline or water-white distillation should be filled up with bricks, providing a very large surface. (6) The use of rectification columns will considerably increase the fuel and steam consumption.

Rectification of Gasoline from Crude Oil.—(*G. Torosyan, Azerbeidj. Oil Industry,* 1927, *No.* 6-7, 48-51. *C. A., Nov.* 10, 1927, *p.* 3735). A rectifier adapted to a continuous distillation unit is described with equations, drawing, layout, etc.

Treating

Continuous Treatment of Light Oils.—(*Y. E. Emmuil, Azerbeidj. Oil Industry*



High temperatures without overheating

Foster Tube Stills are successfully heating oil to final temperatures as high as 1100 deg. Fahr. without overheating the oil or the heater, and in many installations are successfully taking an overhead of 90 per cent of the throughput without cracking.

Performances such as these form one reason for the rapidly increasing number of Foster Tube Still installations—now in excess of 600.

Foster Tube Still design prevents overheating by rapid and positive circulation, assures uniform heating by arranging all tubes to supply heat with practically equal effectiveness, and secures minimum fuel consumption by gradual, continuous, thorough heating effect with complete combustion.

FOSTER WHEELER CORPORATION
165 Broadway, New York

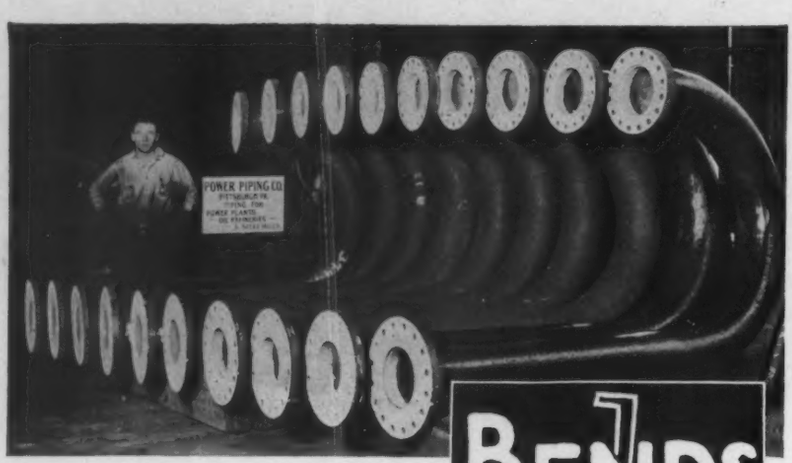
BRANCHES IN PRINCIPAL CITIES

FOSTER WHEELER

FRACTIONATING TOWERS HEAT EXCHANGERS
STEAM JET AIR PUMPS SUPERHEATERS
TUBE STILLS VACUUM PUMPS
WATER COOLED FURNACE SURFACES
BRASS AND COPPER TUBING AND PIPE

AERO UNIT COAL PULVERIZERS
AIR HEATERS CENTRIFUGAL PUMPS
CONDENSERS COOLING TOWERS
ECONOMIZERS EVAPORATORS
EXPANSION JOINTS FEED WATER HEATERS

Mention Where You Saw the Advertisement



10" Bends on 26" Radius for Gas Compressors

BENDS!

Power Piping

FOR EVERY OIL FIELD NEED

THE more difficult the problem, the more necessary that experienced engineering minds are put to its solution! Perhaps we can suggest a practical plan to reduce not only first cost but operation upkeep.

POWER PIPING CO. • PITTSBURGH, PA.

SPECIFY Kerlow Gratings and Safety Steps For:

KERLOW
GRATING PRODUCTS
JERSEY CITY, N. J.

SUBWAYS
Boiler Room Floors
Turbine Room Floors

WALKWAYS
Fire Escapes
Platforms

AREAWAYS
Sidewalks
Trench Covers

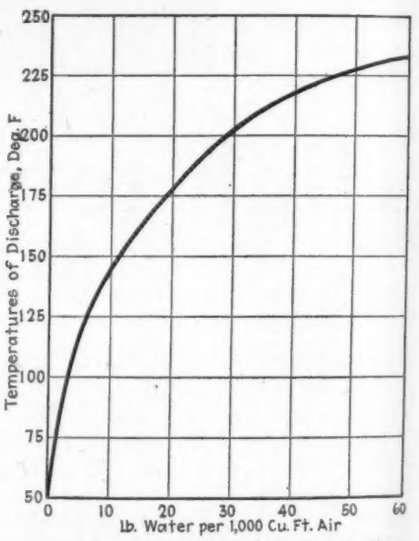
Write for Catalogue F66E

KERLOW STEEL FLOORING COMPANY
220-224 CULVER AVE., JERSEY CITY, N. J.

1927, *No.* 6-7, 64-7. *C. A., Nov.* 10, 1927, *p.* 3736). In a plant for continuous treatment of gasoline and water-white oil, five towers, connected in parallel, are fitted with H_2SO_4. The acid enters the towers on the upper part and is continuously withdrawn from the bottom. The oil enters the towers through fine holes in the lower part, passing the acid in very fine drops and having a large surface for reaction. The oil collected on the top part of the towers is led through pipes to a tower containing soda solution. This tower works on the same principle. As no stirring is required and the whole process is carried out in closed containers, the loss in oil is extremely small.

Maintenance

Freezing of Compressed-Air Lines.—(*Emmarr. Chem. and Met. Eng., Vol.* 34, *No.* 12, *pp.* 763-64). Trouble with the freezing of exposed, compressed-air lines is often encountered during winter. If the quantity of inter-cooler water circulated be decreased, so as to put out air at higher temperatures, so doing will aggravate the condition and more freezing will occur. The curve shown in Figure 1 was prepared to show that with increased discharge temperatures, more water was thrown into the air lines and the dew-point raised, greatly increasing the quantity of condensed water subject to freezing. This water would trap in the lines more readily and freeze solid more quickly. In the curve, the pounds of water carried by 1,000 cubic feet of air is plotted against temperature, assuming complete saturation.



Water Vapor-Carrying Capacity of Air at Various Temperatures

The only way to prevent freezing, where it is impossible to move the lines into warm buildings, is to cover them and to insure thorough drainage by sloping toward drips that are located in warmer places and trapped. In this way, the probably high velocity of the air will carry the condensed moisture through the exposed sections. At the same time, if these exposed lines are covered, not much

National Airoil Burners

Patented
Dec 31, 1918
Dec. 12, 1922
Apr. 15, 1924

For Power Plants and Stills and all Industrial Furnaces

NATIONAL AIROIL BURNERS
are internal atomizing burners—inside mixers—operating with either steam or compressed air; and burn as steady as a gas flame with any grade of fuel. Set your fire the way you want it, and it will burn the day through without watching or readjusting.

NATIONAL AIROIL BURNERS
will handle the heavy residuum from cracking stills without requiring continual removal for cleaning, an immense factor in economical plant operation.

NATIONAL AIROIL BURNERS
when operating under boilers will use less than one per cent of the steam for atomizing the oil. The old style steam atomizing burners use from three to seven per cent.

NATIONAL AIROIL BURNERS
give a soft gaseous flame that does not injure brick work or boiler tubes. Made with flat or round tips.

Write for our Bulletin No. 21

National Airoil Burner Company

Factory: S. W. Cor. 9th and Thompson Sts.
Sales Rooms: 1327 Girard Avenue
PHILADELPHIA, PA.

Oil Burners and Oil Burning Equipment

For cracking process in oil refineries we furnish Aluminum Armored Asbestos filled Gaskets and Corrugated Armco Iron or Monel Metal Asbestos encased.

Copper rings 3/16" thick for 4 and 5" O. D. tubing.

Washers or gaskets made of Aluminum, Copper and other Metals.

Write for Prices.

METALLO GASKET CO.

NEW BRUNSWICK, N. J.

For Protection

When paint spraying outside work use the New Improved Pulmosan Dustproof Aluminum Respirator.

For painting inside of tanks and tank cars use the Pulmosan Airline Mask with blower attachment.

Write for Descriptive Literature

Pulmosan Safety Equipment Corp.

384 Jay Street Brooklyn, N. Y.

drop in temperature will be experienced, within limits, due to its rapid travel.

OF PRACTICAL INTEREST TO THE REFINER AND CHEMICAL ENGINEER

Heat Transfer

Notes on the Calculation of Problems in Heat Transfer. — (*Zwieki. Refrig. Engr., Vol* 14, *No.* 3, *Sept.* 1927, *pp.* 100-103. *Mech. Eng., Vol.* 49, *No.* 11, *p.* 1278). The logarithmic mean temperature difference is shown by author to be applicable only in a special case of heat flow, when specific heats of the two liquids passing through the exchanger are constant, and their flow steady; this is shown for the ammonia condenser, and countercurrent cooler of a liquid air column, where differences of as much as 40 per cent may exist between the effective and logarithmic mean differences; except in one case, the latter function has no real meaning and is only an approximation if used; graphical method is discussed, by means of which effective mean difference can be found; this method lends itself to finding the true value of the coefficient of heat transfer at any point of cooling surface; these points have an interesting bearing on materials of refrigeration.

BOILERS AND BOILER FURNACES

Construction and Operation

Boiler Feed-Water Treatment.—(*Caldwell. Indus. Power, Vol.* 8, *No.* 4, *Oct.* 1927, *pp.* 54-58 *and* 94 *and* 96). Discusses necessity for treating boiler feed-water and various methods of treating.

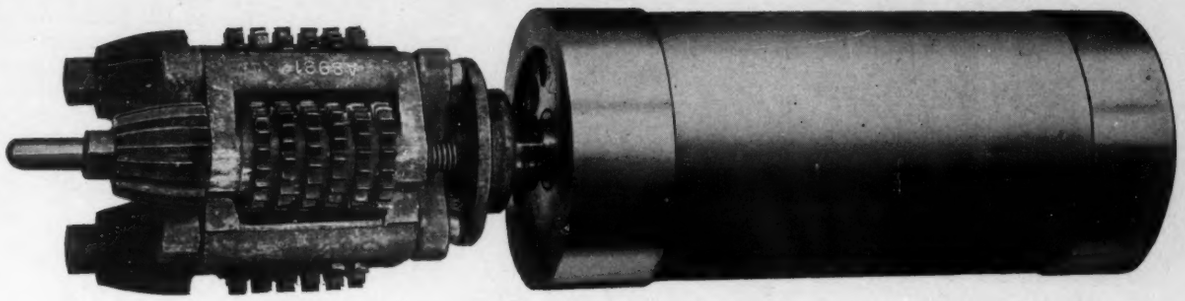
Treating Boiler Feed-Waters.—(*Watson. Power House, Vol.* 21, *Nos.* 18 *and* 19, *Sept.* 20 *and Oct.* 5, 1927, *pp.* 17-20 *and* 117-121). Discussion of common impurities found in boiler feed-water, chemical treatment to prevent foaming and corrosion, and explanation of chemical reactions involved, with reference to external purification.

Automatic Regulation of Boiler Furnaces.—(*Schulz. Warme, Vol.* 50, *No.* 26, *July* 1, 1927, *pp.* 445-449. *Brief translated abstract in Eng. and Boiler House Rev., Vol.* 41, *No.* 4, *Oct.* 1927, *p.* 205.) Problem of operating automatically a bank of boilers is not so simple as automatic regulation of a single boiler; unless suitable precautions be taken, total load soon becomes divided unevenly between several boilrs; various systems are described.

Gas-Fired Steam Boilers.—(*Greenleaf. Chem. and Met. Eng., Vol.* 34, *No.* 9, *Sept.* 1927, *pp.* 566-68). Study of economics involved; there are two principal types of gas-fired boilers in general use; cast-iron type is limited to use for comparatively low pressures, while steel fire-tube type can be used over practically entire range of working pressures.

Boilers with Water-Walls.— (*Toensfeldt, Combustion, Vol.* 17, *No.* 5, *Nov.* 1927, *pp.* 293-97). Shows how presence of water-walls in furnace not only makes possible higher ratings than may be obtained with old firebrick-lined furnaces,

ROTO TUBE CLEANERS

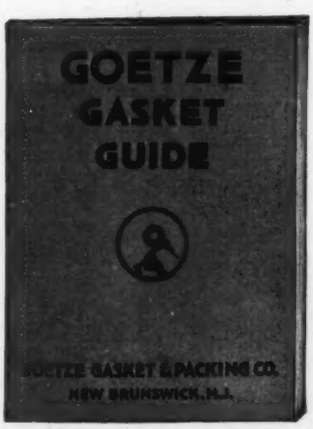


Roto Air-Driven Heavy Duty Cleaner
For

CRACKING STILLS

THE ROTO CO. **Sussex Avenue and Newark St.,** **NEWARK, N. J.**

G O E T Z E



Metal-Asbestos Gaskets
for
Modern Refinery Practice

Write for this 36-page "Guide"

Goetze Gasket & Packing Co.

28 Allen Ave., **New Brunswick, N. Y.**

Forged Steel Products

HIGH GRADE LINES — QUICK SERVICE

Valves	Flanges
Ells	Couplings
Tees	Bushings
Unions	Reducing Fittings
Plugs	Ground Joint Unions

ALSO

Tycos Instruments	Gate Valves
Reducing Valves	Electric Cranes and Hoists
Pump Governors	All-Steel Hand Trucks
Liquid Level Controls	Machine Bolts
Back Pressure and	Rivets
Vacuum Regulators	Air Preheaters
	Air Cleaners

CAST STEEL FITTINGS—STEAM SPECIALTIES
ACIMET "NON-CORROSIVE" LEAD VALVES

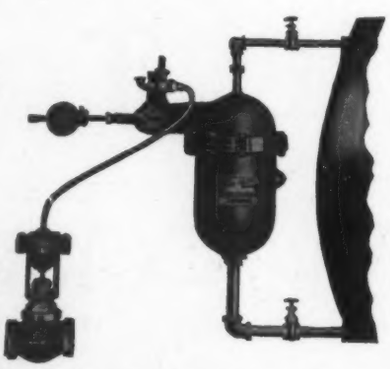
Speed and efficiency in handling your orders

Maintenance Engineering Corp.

W. J. PEDDIE, President — L. J. BURDA, Secretary-Treasurer
Tel. P-5580 — HOUSTON, TEXAS — P. O. Box 1402

In Gasoline Recovery

THE "VIGILANT" Oil Level Regulator



In manufacturing gasoline by absorbing it in oil and then separating it from the oil by distillation, a constant oil level must be maintained in both the absorbing tank and still.

For this purpose, we offer the "Vigilant" Oil Level Regulator, adjustable to any type of absorber or steam still, which maintains a constant oil level under all conditions of temperature and pressure.

It is an Automatic Regulator of the Oil Supply in Absorber Tanks

Regulator mounted on side of tank, so that center of chamber is opposite to oil level desired.

WRITE for the Chaplin-Fulton 60-page catalog! It's free—and contains data on our many time-tested and proven gas regulators, that you will find invaluable in your work.

The Chaplin-Fulton Mfg. Co.

Organized 1884—oldest builders of gas regulators in the country. Built in all sizes, from 1-inch to 24 inches; for all service, 1 oz. up to 1,600 lbs. Pressure to square inch.

28-24 Penn Ave., Pittsburgh, Pa.

but also how their presence betters relative performance of boiler at same steaming rates.

Tests with the Roucka Boiler Control.—(*Boltze. Warme, Vol.* 50, *No.* 26, *July* 1, 1927, *pp.* 461-64. *Brief translated abstract in Eng. and Boiler House Rev., Vol.* 41, *No.* 4, *Oct.* 1927, *p.* 182). Complete Roucka system for automatic operation controls speed of combustion pressure in combustion chamber, feed-water and fuel supply; results obtained from observations on boilers in power stations with fluctuating load; author concludes that automatic control makes possible considerable gain in efficiency, even in best conducted plants.

Large Boiler Units and Heat Transfer.—(*Page. Power Engr., Vol.* 22, *Nos.* 259 *and* 260, *Oct. and Nov.* 1927, *pp.* 377-380 *and* 425-427). Oct.: Thermal losses of modern boiler unit are analyzed. Nov.: Novel method of boiler construction by which chimney and radiation losses are said to be greatly reduced.

Boiler Settings.—(*Dignan. Engrs.' Soc. West. Pa. — Proc., Vol.* 43, *No.* 6, *July* 1927, *pp.* 279-302 *and* (*discussion*) 303-305). Points out how conditions can be met in practical and commonsense manner; deals more with large installations, as conditions are more severe and lessons learned can be applied with profit and discrimination to smaller installations.

Increasing Height of Boiler-Settings.—(*Singleton. Power House, Vol.* 21, *No.* 20, *Oct.* 20, 1927, *pp.* 20-21). View is expressed that when boilers are set higher than is customary and careful firing methods adopted, they can be run with practically clean surfaces if tubes are cleaned every 10 or 12 hours.

The Production of Seam from Waste Heat.—(*Ebner. Chem. and Met. Eng., Vol.* 34, *No.* 9, *Sept.* 1927, *pp.* 572-74). Although waste heat boilers of fire tube type have been installed to operate at steam pressures up to 250 pounds, greater number are in service at 150 pounds or less; combination of better heat recovery and low initial cost of equipment, in an operation at moderate pressure, usually outweighs benefits to be derived from high-pressure steam.

Waste-Heat Boilers.—(*Crane. Combustion, Vol.* 17, *No.* 5, *Nov.* 1927, *pp.* 303-306 *and* 310.) Boilers for waste-heat purposes are horizontal return-tubular, horizontal or vertical water-tube; settings should be made heavier and more substantial with waste-heat than with regular boilers.

Alignment Chart for Determining Minimum Combustion Air and Maximum Carbon Dioxide.—(*Kulmann. Power, Vol.* 66, *No.* 19, *Nov.* 18, 1927, *pp.* 710-711.) Chart is based upon equation for amount of carbon dioxide in waste gases when minimum amount of air is supplied and composition of fuel is known.

Steam Metering and Control.—(*Hammond. Chem. and Met. Eng., Vol* 34,

For Protection of Interior Surfaces of Storage Tanks

For underside of tank top and upper ring as protection against **Hydrogen Sulphide Gas** *use* **Rubshell** priming and No. 5.

For protection against **Salt Water** and **Dilute Acids** in bottom of tank and lower ring *use* **Rubshell** priming and No. 1.

Sole Manufacturers

INTERNATIONAL COMPOSITIONS COMPANY

25 Broadway, New York City

Agents for Texas
J. A. ROSSITER CO., HOUSTON, TEXAS

Agents for Louisiana
WOODWARD WIGHT CO., NEW ORLEANS

Agents for California
C. G. CLINCH & CO., SAN FRANCISCO AND SAN PEDRO

BUCKLEY'S

MULTI-SYPHON

VENTILATORS

Are now being used throughout the United States and five foreign countries in **serving the oil industry.**

There's A Reason!

"BETTER VENTILATION AT LESS EXPENSE,"

which gives you full details as to construction, theory, material, capacities, weights and prices.

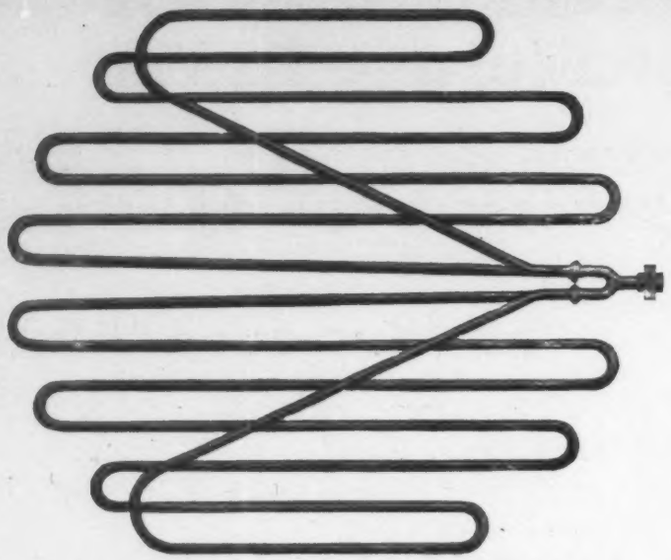
Write for catalogue.

Manufactured only by

The American Cornice Works Co.

Wichita, Kansas

PITTSBURGH COILS

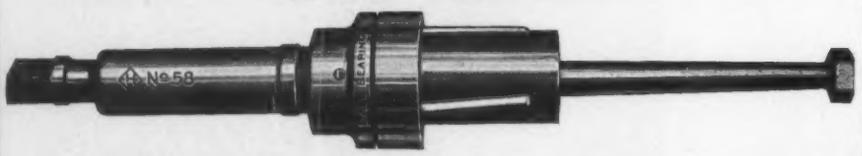


SPECIALISTS in Coils for oil country and refinery use. Electrically welded, continuous. Send us your blue prints or rough sketch; let us quote you on Coils that give real service.

Pittsburgh Pipe Coil & Bending Co.

P. O. BOX 975, PITTSBURGH, PA.

Heavy Duty Expanders for Still Tubes



Tools for the Oil Industries

Hydraulic Pressure Pumps, 8000 pounds
Tube Expanders for Cracking Still Tubes
Hydraulic Pressure Pumps, 2000 pounds.
Tube Expanders for Condenser Tubes
Hydraulic Pressure Pumps, 500 pounds.
Tube Expanders for Steam Boilers
Screw Punches for Structural Shapes
Tube Expanders for Pipe Work
Screw Punches for Plate Work
Flaring Tools for Still Tubes
Beading Tools for Still Tubes
Hydraulic Jacks
Hydraulic Punches

A. L. HENDERER'S SONS

Wilmington, Del.

Established 1870
Expanders since 1884

No. 9, Sept. 1927, *pp.* 569-571.) Meters recording steam flow and air flow should be installed on each boiler, not only to show distribution of load on boiler, but to guide firemen in controlling rate of fuel feed, air supply, etc., to generate required amount of steam most efficiently.

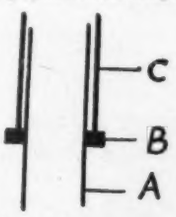
OF PARTICULAR INTEREST TO THE CHEMIST

Testing and Analysis

Determination of Volatility of Gasoline.—(Stevenson and Babor. Ind. and Eng. Chem., Vol. 19, *No.* 12, *pp.* 1361-66.) The dew point is the best indication of the temperature of complete vaporization, under equilibrium conditions, of gasoline alone or mixed with air. This dew point may be determined easily, rapidly and reliably by means of an optical effect shown by a new device called the "black-surface dew indicator."

The disadvantage of actually determining the dew points of the different air-fuel mixtures may be avoided by the use of a graph showing the relation between the dew point of the gasoline alone at 760 mm. pressure and the dew points of the different air-gasoline mixtures. This equilibrium end point or dew point of gasoline alone is especially easy to determine with the black surface dew indicator, and its relation to the dew points of the air-gasoline mixtures is sufficiently definite for their derivation by means of a graph with practical accuracy. In this way, one simple determination of the dew point of gasoline alone suffices for the deduction of the temperatures of complete vaporization of all the practical air-gasoline mixtures.

Device for Maintaining Flame Height in Sulphur Determinations.—(Kelly. Ind. and Eng. Chem., Vol. 20, *No.* 1, *p.* 101.) In the recently published Report of Committee D-2 of the A. S. T. M. the members of Sub-Committee VII on Sulphur Determination and Differentiation call attention to the difficulty of maintaining the flame at the prescribed height.



A = wick tube
B = rubber ring
C = 13-mm. length of closely fitting tubing

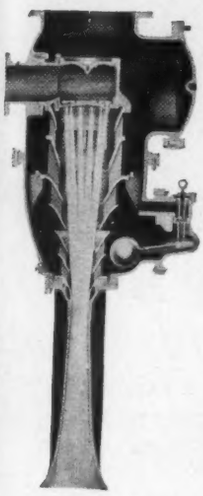
FIGURE 1

The author has found the device described by Squire (J. Soc. Chem. Ind., 45, 466T (1926) to be of great value where accurate flame-height adjustment is required during sulphur determinations, especially in a study of the effect of rate of burning, etc., on the accuracy of such determinations. See Fig. 1.

The device is briefly as follows: By filling the wick tube with glass wool and having trimmed the wick flush with the

Jet Condensers

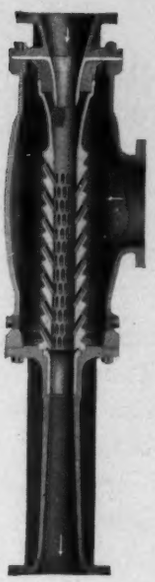
operate without air pumps



The water jets do double duty by condensing the vapors and entraining the air and non-condensable gases.

MULTI-JET CONDENSERS
are built in 30 standard sizes.
Vapor connections 12″ to 66″
Bulletin 5-A

EDUCTOR (single jet) CONDENSERS
are built in 18 standard sizes.
Vapor connections 1½″ to 24″
Bulletin 5-B



These condensers may be installed as barometrics or may be set up as low level jets—in either case no air pumps.

Recommended for engines, turbines, acid concentrators, evaporators, etc., in the Oil Industry

SCHUTTE & KOERTING CO.,
1253 N. 12TH STREET **PHILADELPHIA, PA.**

OIL METERS *for* CRACKING PROCESSES

The EMPIRE Made to withstand working pressures of 300 pounds to the square inch. Special types can be furnished for higher pressures if required. Standard models for general use will sustain a working pressure of 150 pounds. Sizes range from ⅝ inch to six inches, and are supplied either with a horizontally placed straight-reading register, or a clock-like vertical dial, as illustrated here, which can be turned to face in any one of four positions.

The EMPIRE is a positive displacement meter, operated by an oscillating piston. It is accurate, and *stays* accurate. The only oil meter having this feature of continuous and lasting accuracy.

Send for fully descriptive circular 110-*R*.

NATIONAL METER CO., 299 Broadway NEW YORK

Announcement

The Refinery Supply Company purchased the Ac-Me Company and will continue under the name of R-S Manufacturing Company at 3408 Main Street, Dallas, Texas. Following items will be manufactured—Recording Gravitometer, Specific Gravity Gas Balance, Lookboxes, Orifice Meter Calculators, Vapor Tension Bombs, Dome Covers, Water Column, Pressure and Vacuum Pumps.

Repair Department

For Hays Gas Analyzers, Meriam Manometers, etc.

The Refinery Supply Company

TULSA, OKLAHOMA
Fourth and Detroit

DALLAS, TEXAS
917 Santa Fe Bldg.

THE ACCURACY R.S.C. TULSA

top of the tube, any flame from 2 cm. in height to a mere flicker can be obtained with natural gasoline in the lamp. The novel feature is that the flame can be kept at a definite height from the beginning of a burning, without interruption of the test, by raising or lowering the small length of tubing which rests on the rubber ring.

Method of Estimating Lead in Lubricating Oils.—(*Alfred E. Levey. Chemist-Analyst No.* 47, 7 (1926); *Chem. Zentr.* 1926, II, 1711. *C. A. Nov.* 10, 1927, *p.* 3738.) Carefully ignite 3 grams of material, leach the ash with 100 cc. of 4 *N* HNO_3 diluted to 150 cc. and electrolyze.

Petroleum Research and Experimental Work

Sulphur in Gasoline From the Automobile Standpoint.—(*Mougey. Ind. and Eng. Chem., Vol.* 20, *No.* 1, 18-21.) It has been estimated that if the oil industry could raise the sulphur limit of gasoline from 0.10 per cent to 0.30 per cent, a saving of $50,000,000 per year in refining costs would be possible. It is recognized that the cause of corrosion in automobiles is water formed by the combustion of the fuel, and that the corrosion effect of this water is greatly increased if it is contaminated with acids resulting from the burning of the sulphur in the fuel. Crankcase ventilation and control of the jacket-water temperatures by thermostats have been recommended to eliminate the condensation of water from the burning of the fuel and thus combat this corrosion. Record of tests and of performance in service, in the hands of the public, of engines equipped with such devices and operated on fuels of different sulphur content are given. Although the thermostats and ventilators are of very great value in

Petroleum Chemists:

Wanted immediately for large refinery in Chicago District, Assistant Chief Chemist and Experimental Chemist. Applicants state full particulars including age, education, experience, and send photograph. None without considerable refinery experience need apply. Address Box 15, c/o Refiner & Natural Gasoline Mfr., Houston, Texas.

Electrically Driven Centrifuges
Hand Centrifuges
WRITE
WILLIAMS, BROWN & EARLE, Inc.
Manufacturers of Laboratory Apparatus
918 Chestnut St. Philadelphia, Pa.

BONER & SHELDON
Manufacturing Engineers
Fractionating Towers, Absorption Towers, Vertical Stills, Distillation Equipment.
514 Merchants National Bank Bldg.
Los Angeles, Cal.

Why not the "Comfortable Great Northern" on your next visit to Chicago?

Arriving in Chicago, you are within convenient distance of this famous hotel, which is in the central business section, less than one block from State Street, the great shopping thoroughfare, and close to the theater, financial and wholesale districts. The Field Museum, Art Institute and Soldier Field Stadium are within easy walking distance.

As a Great Northern guest you can enjoy every convenience and real solid comfort without extravagance.

400 *Large, Bright Livable Rooms, $2.50 a day and up.* For two persons in any room the additional cost is only $1 a day. No extra charge over main restaurant prices for meals sent to guest rooms. Garage near. Tourists' cars delivered without service charge.

GREAT NORTHERN HOTEL
Chicago

Dearborn Street
From Jackson to Quincy

SEAMLESS STEEL STILL TUBES

Thousands of Babcock & Wilcox open hearth seamless steel still tubes are in service in refineries throughout the country.

These tubes have been supplied to various specifications, either with plain ends or upset as ordered.

Many of them are thirty feet long, made hot finished by a process perfected by this Company, for tubes of unusually long length.

The more common sizes are carried in stock at the Mill for immediate shipment.

THE BABCOCK & WILCOX TUBE CO.

Works: Beaver Falls, Pa.

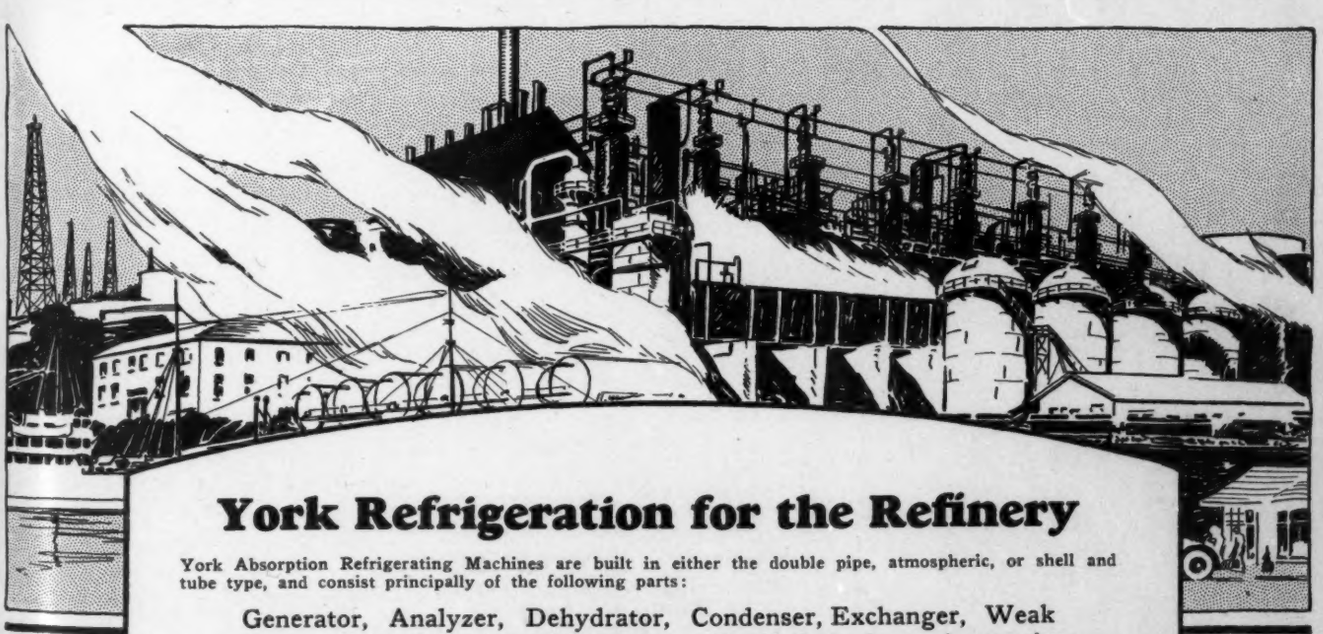
General Sales Office: 85 Liberty Street, New York

BRANCH OFFICES

AMARILLO, TEXAS.....208 Polk Street
ATLANTA, GA. .....Candler Building
BOSTON .....80 Federal Street
CHICAGO..... Marquette Building
CINCINNATI..... Traction Building
CLEVELAND..... Guardian Building
DALLAS, TEXAS.....Magnolia Building
DENVER.....444 Seventeenth Street
DETROIT..... Ford Building
GALVESTON, TEXAS.....414 Security Building
HOUSTON, TEXAS.....Electric Building
LOS ANGELES.....Central Building

BRANCH OFFICES

NEW ORLEANS.....344 Camp Street
PHILADELPHIA..... Packard Building
PHOENIX, ARIZ.....Heard Building
PITTSBURG.....Farmers Deposit Bank Building
PORTLAND, ORE. .....Failing Building
SALT LAKE CITY.....Kearns Building
SAN ANTONIO, TEXAS.....
.....511 Builders Exchange Building
SAN FRANCISCO.....Sheldon Building
SEATTLE.....L. C. Smith Building
HONOLULU, T. H.....Castle & Cooke Building
HAVANA, CUBA.....Calle de Aguiar 104
SAN JUAN, PORTO RICO...Royal Bank Building



York Refrigeration for the Refinery

York Absorption Refrigerating Machines are built in either the double pipe, atmospheric, or shell and tube type, and consist principally of the following parts:

Generator, Analyzer, Dehydrator, Condenser, Exchanger, Weak Aqua Cooler, Absorber, Strong Aqua Tank, Anhydrous Ammonia Receiver and Aqua Ammonia Pump.

This equipment is particularly adaptable to Refinery requirements, and can be relied upon to deliver low, dry temperatures WHEN and WHERE needed.

YORK
ICE MACHINERY CORPORATION
YORK PENNA

Mention Where You Saw the Advertisement

combating corrosion, it is concluded that, inasmuch as a large number of cars are not so equipped, *an increase in the sulphur content of motor fuel at the present time is not in accord with the best interests of the automobile industry and the public.*

Effect of Sulphur in Gasoline on Wrist-Pin corrosion in Automobiles.—(Riggs. Ind. and Eng. Chem., Vol. 20, *No.* 1, *pp.* 16-17.) Experiments were made during the winter of 1922-23 by Mr. Kreis of the Continental Motor Company, and the author using a Jordan engine fitted with new wrist-pins, piston rings for each experiment. The engine was run one hour and allowed to stand idle one hour. All work was done when the temperature was below freezing, though not very cold. Each test represented from 60 to 75 hours' running time. Results showed that (1) when using a gasoline of 0.040 per cent sulphur there was no corrosion of wrist-pins, etc., and that the water condensed in the crankcase contained no free acid; but did contain some ferrous sulfate; (2) when using a gasoline of 0.151 per cent sulphur the corrosion was very appreciable and the water in the crankcase contained free sulfuric acid in small quantities; (3) when using a gasoline of 0.458 per cent sulphur the corrosion was very serious and the crankcase water quite acid.

Natural Gasoline Industry

Progress of the Natural Gasoline Industry for 1926-1927.—(*Bernard. Mech. Eng., Vol.* 50, *No.* 1, *pp.* 42-44.) California construction in 1926-27 entailed no novel features. High hydrogen-sulfide content of Panhandle gas necessitated efforts so to design equipment as to withstand corrosive action of gas, which problem has been only partly solved. Special equipment and new processes have been required to treat gasoline obtained from Panhandle gas. In last half of 1927 experiments were started in transporting Panhandle crude admixed with natural gasoline. In 1926-27 extensive use was made of the "air or gas-lift principle," same being used, first, solely for increasing the production of crude oil, later, as a means for producing oil and extracting gasoline with the same equipment. In plants constructed late in 1926 and early in 1927 absorption-type units were placed on the discharge of the low-stage compressors to extract the gasoline. In March, 1927, a major oil company put into operation a plant designed not only to extract gasoline efficiently under compression methods, but also to furnish high-pressure gas for producing crude oil by the gas lift. Chief problem encountered was design of a system of controls to enable the operation of each individual well under the most favorable conditions and to permit the "kicking-off" of any well or wells without interference with other operations. This problem was solved by design of special cylinders, the use of which permits desired results. This type of compression plant is now in wide favor.

In 1927 superheated steam was used for the first time in natural gasoline plant for power and process requirements, the ultimate success of which is too recent to report on results. The use of base exchange and lime-soda water-treating systems has become more general than previous periods, as has the application of automatic controls, not only in the power plant but in the process equipment as well. Gas-injection on two-cycle internal combustion engines, a new development being applied in the natural gasoline industry, apparently will be comparable in economy with results attained in four-cycle operation. Design of cooling towers has so improved that such towers have largely supplanted spray ponds. For cooling and condensing service, shell-and-tube type of equipment is rapidly becoming pre-eminent, although atmospheric-type coils continue to be used.

INDEX OF ADVERTISERS

Alfit Packing Company 46
American Cast Iron Pipe Company 38
American Cornice Works 125
American Radiator Company 28
American Schaeffer & Budenberg Corporation 118

Babcock & Wilcox Tube Company 129
E. B. Badger & Son 87
Banner Rock Products Company ..... 3rd Cover
Bessemer Gas Engine Company 10
Biggs Boiler Works 101
Boner & Sheldon 128
Botfield Refractories Company 117
C. F. Braun & Company ..... 2nd Cover
Bristol Company 103
Brown Instrument Company ..... Insert

Campbell Engineering Company 99
J. A. Campbell 8
Chapiln-Fulton Manufacturing Company 124
Chestnut & Smith Corporation 9
Chicago Bridge & Iron Works 19
Clark Brothers Company 13
Cook Paint and Varnish Company 105
Cooling Tower Company 112
C. & G. Cooper Company 54
Crandall Packing Company 114
Crosby Steam Gauge Company 113

Darling Valve & Manufacturing Company 81
DeLaval Steam Turbine Company 46
Detroit Graphite Company 111
Durion Company 116

Electric Controller & Manufacturing Company 42
Elliott Company 18

Fisher Governor Company 32
Foster-Wheeler Corporation 119
Foxboro Company, Incorporated 31

Goetze Gasket & Packing Company 123
Goulds Pumps, Incorporated 41
Gray Processes Corporation 45
Great Northern Hotel 128
Graver Corporation ..... Front Cover
Griscom-Russell Company 40

Hammond Iron Works 49
A. L. Henderer's Sons Company 126
Hill, Hubbell & Company 23
Hill-McCanna Company 15
B. Mifflin Hood Brick Company 112
Hope Engineering & Supply Company 47

Insulating Products Company 27
International Compositions Company 125

Byron Jackson Pump Company 83
Jackson Engineering Corporation 21
Johns-Manville Corporation 35

Kerlow Steel Company 126
M. W. Kellogg Company 12

Laclede-Christy Clay Products Company 35
Liberty Manufacturing Company 33
Leeds & Northrup Company 37
B. P. Lientz & Company 36
W. E. Lummus Company 34

Mason Regulator Company 39
Maintenance Engineering Corporation 124
Metals Coating Company of America 11
Merco-Nordstrom Valve Company 17
Metric Metal Works 22
Metallo Gasket Company 122
Midwest Piping & Supply Company 52
McCord Radiator Company 104
A. Y. McDonald Manufacturing Company ..... 4th Cover

National Meter Company 127
National Airoil Burner Company 121
National Transit Pump & Machine Company 50
National Tube Company 24
Nellan Schumacher Company 7
North American Car Company 89
Northern Equipment Company 110

Oakite Products, Incorporated 113
Ohio Steel Foundry Company 14
Oil Conservation Engineering Company 30

Petroleum Iron Works 7
Pittsburgh Pipe Coil & Bending Company 120
Pittsburgh Steel Products Company 115
Power Piping Company 126
Pulmosan Safety Equipment Company 122

Quigley Furnace Specialties Company 44

Reading Iron Company 90
Reading Steel Castings Company 50
Refinery Supply Company 120
Ross Heater & Manufacturing Company 43
Roto Company 127

Sarco Company 114
Schutte & Koerting Company 125
A. O. Smith Corporation 79
Smith Separator Company 87
Southern Cornice Works 110
Southwest Engineering Corporation 29
Struthers-Wells Company 48
Stockham Pipe & Fittings Company 4-5
Sun Company 6

Taylor Instrument Company 6
Tulsa Boiler & Machine Works 10

United Iron Works 8
Universal Oil Products Company 1

Henry Vogt Machine Company 48

Westcott & Greis 48
C. H. Wheeler Manufacturing Company 2
Williams, Brown & Earle 120
Wyatt Metal & Boiler Works 47

York Manufacturing Company 4